Vol. XXXII, No. 1, 2007

Man and Environment

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Indian Society for Prehistoric and Quaternary Studies

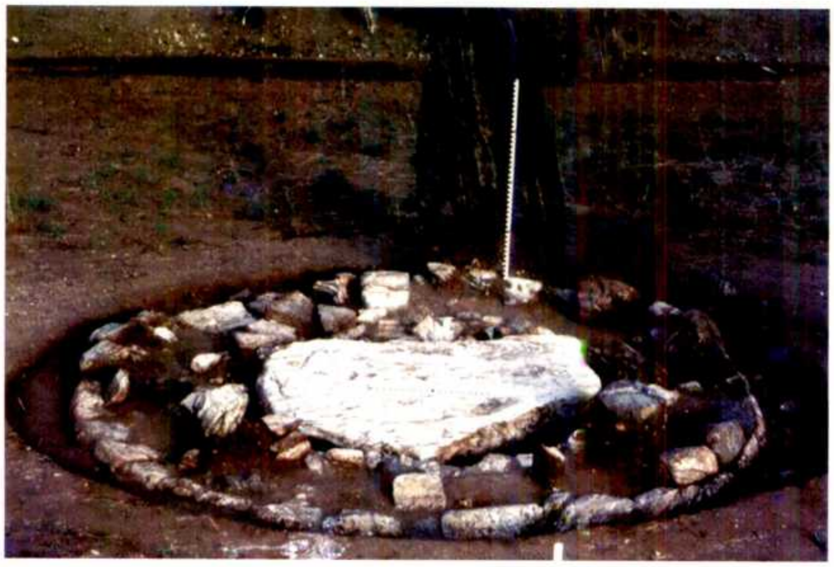

Fig. 1: Kodumanal: An Iron Age grave with a menhir

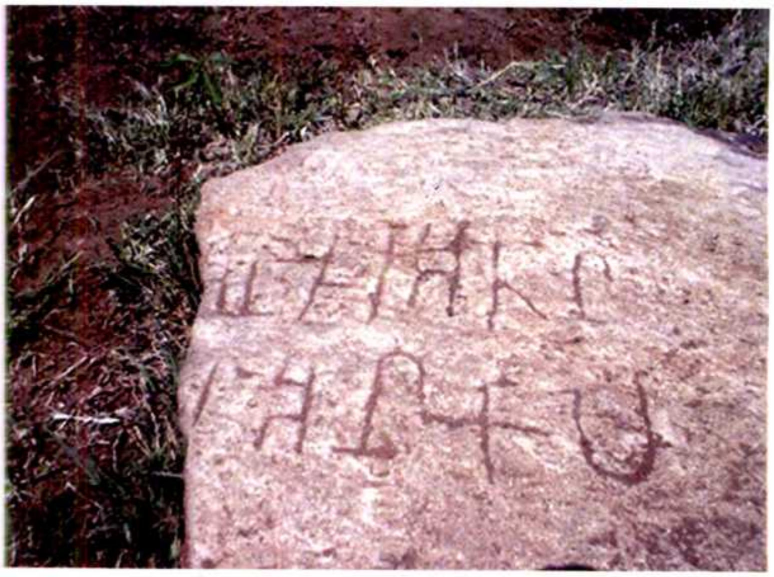

Fig. 4: Pulimankomabi: Hero Stone (No. 1) engraved with Tamil-Brahmi Script

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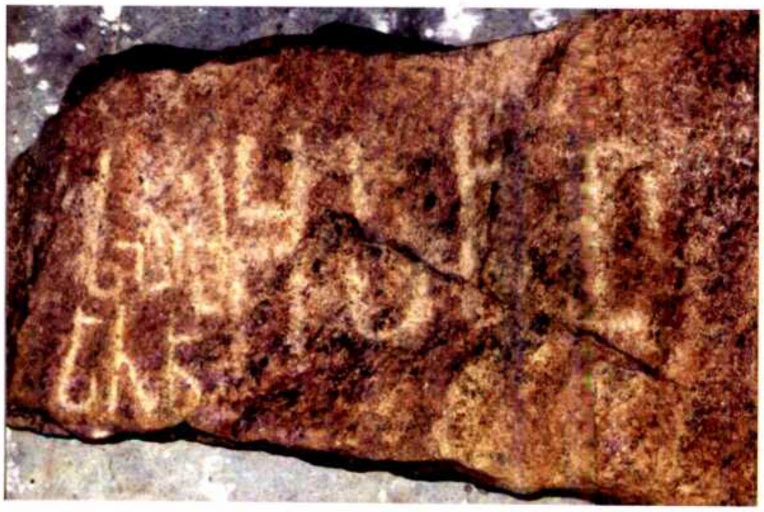

Fig. 6: Pulimankomabi: Hero Stone (No. 3) engraved with Tamil-Brahmi Script

K. Rajan and Yatheeskumar, *Man and Environment*
XXXII(1): 39-45 [2007].
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Man and Environment

Journal of the Indian Society for Prehistoric and Quaternary Studies

Editor: V.N. Misra
Joint Editors: P.P. Joglekar Shanti Pappu

Editorial

This issue of the journal, like the earlier ones, carries rich and varied fare. Professor V.D. Misra's Presidential address, delivered at the XXXIV Annual conference of the Indian Society for Prehistoric and Quaternary Studies, held at Jiwaji University, Gwalior in December 2006, presents a comprehensive and succinct review of the prehistory of the South Central Ganga valley and the Kaimur and Vindhyan plateaux to the South. Sustained research by many scholars, specially those of the University of Allahabad, Banaras Hindu University, and U.P. State Archaeology Department, in recent decades have considerably added to our knowledge of the archaeology of the region, especially of the early beginnings of agriculture. This new data is very competently synthesized by Prof. Misra. Dr. Shobhana Gokhale delivered the H.D. Sankalia Memorial lecture at the same conference. Dr. Gokhale has devoted many years to the study of the inscriptions and architecture of the Kanheri caves, and her paper excellently summarizes her work.

A.V. Joshi and S.K. Biswas report the environmental implications of the surface features of quartz grains of Quaternary deposits of the Tapti river in south Gujarat. Sachin Joshi and Vijay Sathe have presented their findings on the fluorine dating of the Pleistocene vertebrate fossils from the Manjara Valley, Maharashtra. L.S. Rao has noted graffiti designs of a human figure on pottery from the Harappan site of Bhirrana in Haryana, and he thinks that these designs represent a dancing female figure similar in body shape and pose to that of the famous bronze dancing girl from Mohenjodaro. R.N. Kumaran and M. Saranya Kumaran report their discovery of dolmens in the Palani Hills in Tamil Nadu. K. Rajan and V.P. Yatheeskumar describe a hero stone from Thathapatti having an inscription in Tamil-Brahmi.

The urbanization of the Ganga Valley has been a subject of considerable interest to many archaeologists. R. Balasubramaniam has brought out the role of steel-quality iron in the process of urbanization as it would have helped in the cultivation of hard clayey soils and manufacture of more efficient tools and weapons. The issue carries two articles on the early historic site of Sisupalgarh which is being excavated jointly by R.K. Mohanty and Monica Smith. They present a preliminary report of the 2006 excavation. S.B. Ota has interpreted earlier excavation data to support the evidence of a stupa at this site. Savita Ghate examines the geomorphic and environmental changes at the early historic site of Sopara on the Konkan Coast. H.P. Ray and Sudha Ravindranath, using satellite data, examine the environmental factors involved in the location of early Chalukyan temples in Karnataka.

As we noted in the editorial of the previous issue, we receive very few articles on the Palaeolithic, Mesolithic and even Neolithic periods, and Quaternary climate and environment. This is a regrettable trend for a journal whose professed aim is to serve the cause of prehistory and Quaternary environment. We again appeal to young researchers to contribute their articles on prehistory and Quaternary environment, and to senior archaeologists to encourage their students to do research in prehistory.

Two senior South Asian archaeologists, Prof. Abu Imam of Bangladesh and Shri M.C. Joshi, a former Director-General of the Archaeological Survey of India, passed away during last one year. The Society puts on record its appreciation of their valuable contribution to the archaeology of their respective countries.

The Society's Website became defunct due to delay by oversight in the payment of the charges. Mr. Arun Sinha, who was instrumental in launching the earlier site, has created a new one, *www.prehistoryindia.com*. He will be slowly putting the information about ISPQS and *Man and Environment* on the site. Readers of the journal and members of the Society are requested to send information about their new discoveries or any other information, which they think will be of interest to fellow members, to Mr. Arun Sinha by email: arunsinha2000@yahoo.com, visit the site, and send their suggestions to Mr. Sinha.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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The Society publishes its bi-annual Journal (June and December) *Man and Environment*. This journal publishes recent and *original* research in the field of South Asian archaeology, including related topics in environmental, anthropological and historical disciplines. The journal has five types of contributions: research articles, short notes, review articles, obituaries, and seminar and conference news. Books are welcome for reviews. The editors will send the book to suitable scholars to be reviewed. All articles submitted for publication are sent to referees. Authors will be asked to revise their manuscripts in the light of these comments. Acceptance of the manuscript will mainly depend on the opinion of the referees.

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V.D. Mirsa, *Man and Environment* XXXII(1): 1-14 [2007].
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Stone Age Cultures, their Chronology and Beginning of Agriculture in North-Central India*

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Introduction

At the outset, I thank the members of the Indian Society for Prehistoric and Quaternary Studies for giving me the honour of delivering the presidential address. I do not feel my work deserves this honour. However, this gesture of the Hon'ble members of this august body indicates that they have a soft corner for me. I wish I could have deserved it. I do hope that my effort would come up to their expectations.

India is a vast country having a continental dimension. It is represented by different eco-zones. The country has been a cradle of human culture since time immemorial. It has witnessed the march of human culture right from the Lower Palaeolithic times. Relics of human culture are being unearthed every year from new corners. A number of institutions are involved in it.

I

For my address I have chosen an area, which has attracted the attention of a number of scholars, both from India and outside. North-Central India (Fig. 1) covering Allahabad, Mirzapur and Sonbhadra districts in U.P. and Rewa and Sidhi districts in M.P. is marked by diverse topographical features (Tewari 1971: 102). It is generally hilly and, characterised by step formation gradually rising from the Northeast to the Southwest marked by rugged and diverse topography. The vicinity of the Kaimur hills lie in the Rohtas district of Bihar is essentially an extension of a similar ecological zone. On the southern margin of the Kaimur hills, are the middle reaches of the Son Valley. Lower Proterozoic Vindhyan sandstone, siltstone, dolomite, limestone and minor igneous and metavolcanic rocks crop up along the Son Valley. These are uncomfortably overlain by Upper Proterozoic/Vindhyan quartzite, sandstone and shale, which form the Kaimur escarpment. This escarpment rises over 300 m above the Son floor. North of the Son is the most prominent physiographic feature of the landscape. Between the two escarps; the Kaimur at the southern extremity and Vindhyachal ridges at the northern extremity; lies the Vindhyan plateau with an extremely irregular surface, intersected by low ridges and valleys, and watered by numerous streams. As an amalgam of ridges and valleys, bare rock expansion, sheltered alluvial basins, thick forest cover and agricultural land, the area is still inhabited mainly by a number of tribal groups with varied primitive cultures. This undulating plateau at many places merges gradually with the Gangetic alluvium in the north (Wadia 1973: 121-133; Singh 197: 597-62, 622-648).

The region, outlined above, is marked by deciduous woodland and dry forest with stands of Sal flanking main water courses. Interspersed with these are open grassy and often swampy areas where drainage is impeded. Bamboo mixed with deciduous trees – *salai*, *khair*, *tendu*, *mahu*, etc., are occasionally present even on top of the Kaimur ridge. Of the surviving game animals, mention may be made of tiger, leopard, sloth bear, *langoor*, monkeys, *nilgai*, spotted deer, *barasingha*, jackal, fox, and wild dogs; etc.

This vast area is drained by the Son and its tributaries on the one hand, and Kudra, Karmanasa, Chandraprabha, Garrai, Jargo, Koi, Chhatar-Ki-Nadi, Khajuri, Ojhala, Belan, Adwa, Seoti, Tundiari, Gurma, Naina, Tons, Paisuni, etc., on the other.

The climate of the region is characterised by a dry and hot summer, a fairly pleasant monsoon and a cold season. The region receives an annual rainfall to the tune of about 1000 mm. However, variation in this from year to year is appreciable. More than 90% of the rainfall is received during the monsoon (July to September). The remaining months are more or less dry. The area occupies an almost a central position between the continental climate of the north and the tropical climate of peninsular India

The soils of the region are mostly sedentary exhibiting *in situ* development. However, extensive pockets of alluvial soils exist particularly in the valleys of the Tons, Belan, Karmanasa, Seoti, etc. The studies made so far have broadly divideed the soils of the region into three groups: (1) upland soil (2) lowland soil (3) riverine soil. Needless to say, the area under discussion, with its rich natural

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* Presidential address delivered during the XXXIV Annual Conference of the Society at Gwalior (2-5, December 2006)

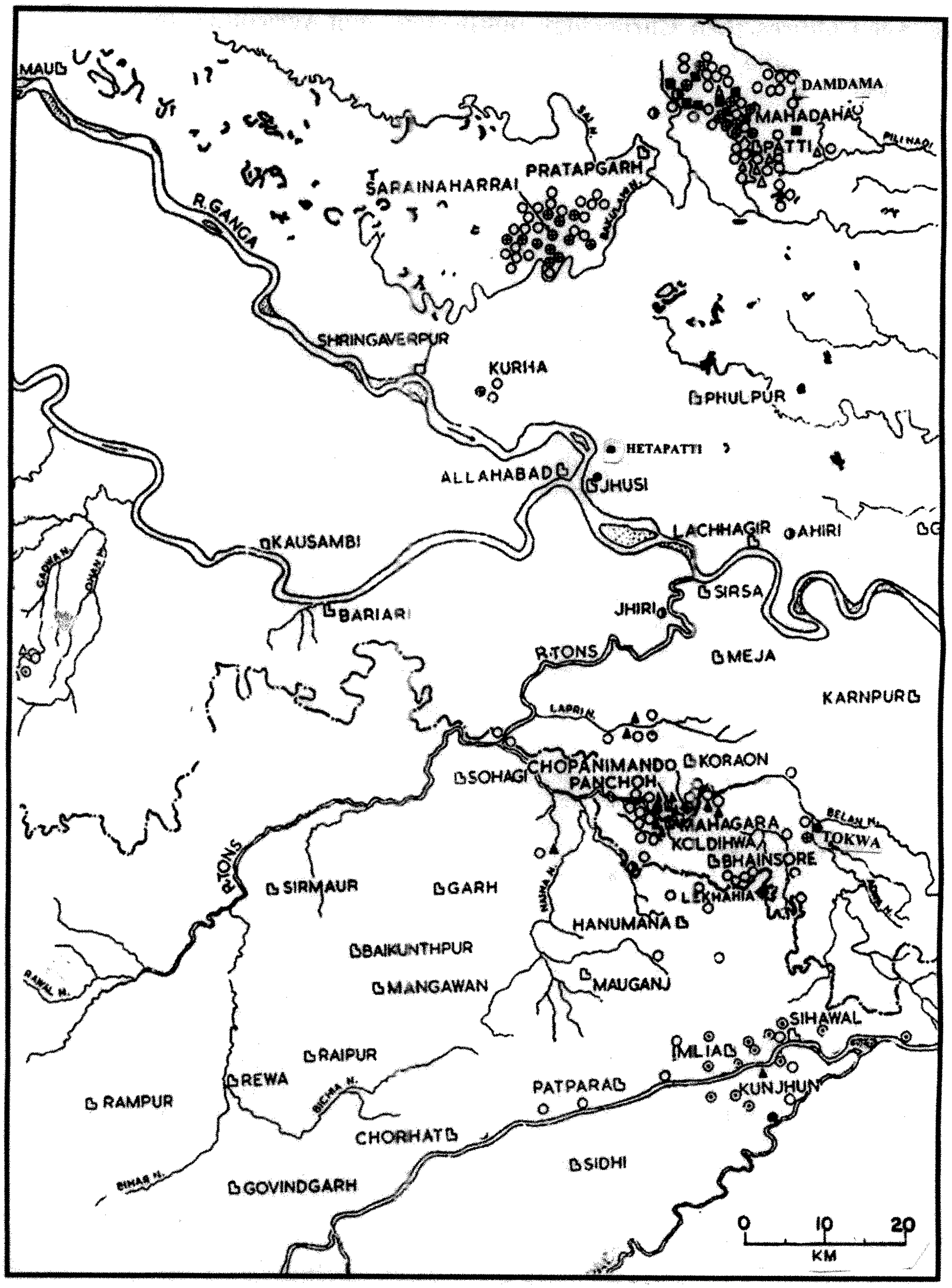

Fig. 1 Sites in the Vindhyas and Mid Ganga Valley

resources: water, occasionally fertile land, flora, fauna, various rocks, etc. provided an ideal habitat for man from very remote antiquity. This is evident by the discovery of stone tools right from Lower Palaeolithic to Neolithic almost without break.

II

The geological and archaeological investigations conducted in North-Central India by the Department of Ancient History, Culture and Archaeology, University of Allahabad and the Department of Ancient Indian History, Culture and Archaeology, Banaras Hindu University have brought to light relics of Stone Age cultures from Mirzapur, Sonbhadra, Allahabad, Chitrakoot and Banda districts of Uttar Pradesh and Rewa, Satna, and Sidhi districts of Madhya Pradesh. The investigations in the Belan and Son valleys conducted over the last four decades have brought to light not only Stone Age tools, but also geological formations ranging from the mid-Pleistocene to the Holocene. The explored area measures 5400 km^2 and 13600 km^2 in the Belan and Son valleys, respectively. Artefacts of even the Lower Palaeolithic to the Mesolithic periods have been found in geological contexts. Thousands of animal fossils have been obtained from the Belan and Son formations. These fossils include those of *Bos namadicus*, *Bubalus*, hippopolamus, crocodile, antelope, elephant, *Equus* sp., tortoise, etc.

The Pleistocene stratigraphy of the Belan section ((Fig. 2) has been studied from Baraundha in Mirzapur to the Belan-Tons confluence in Allahabad. This 'Text Book Section' with an average height of 18 m is composed of 11 units, each having been formed in different climatic conditions (Misra 1977: 30-31; 1997: 61; Williams and Clarke 1984: 633-35; 1995: 282-308; Mujumdar and Rajguru 1985: 96-105). The earliest formation resting on the weathered surface of the Vindhyan rock is laterite, which is capped by boulder conglomerate (cemented gravel I) with an average thickness of 1.5 m. It is composed of pebbles, laterite nodules, laterite plated stone blocks and angular Vindhyan slabs. As the edges of the slabs contained in the deposit are not rolled, it is evident that these have not been carried to any appreciable distance from their original place. The boulder conglomerate is overlain by a 3.5 m thick calcareous brown clay loam. It is devoid of stone pieces. Planar and cross-bedded sandstone gravel, the cemented gravel II, with an approximate thickness of 5 m constitutes the next formation. The stone pieces contained in this gravel are smaller than their counterparts in the boulder conglomerate. It is also well-sorted and well cemented. On account of cross bedding and intervening silty layers, the cemented gravel II is divided into three sub-units – IIA, IIB and IIC from the base. The cemented gravel II is overlain by a sandy-silty deposit of reddish colour divisible into four sub-units – reddish sand, sandy cemented sheets and gravels, reddish sand, and a pebble-bed. A yellowish silt is the next geological unit followed by another gravel, Gravel III. This shell-bearing formation is composed of calcium and iron nodules, angular colluvial fragments of quartzite crusts and nodules and coarse-grained sand and is capped by a buried soil of blackish colour with a thickness varying from 2 to 3 m. The succeeding 4 m aeolian deposit comprises two layers. Martin Williams and his associates (Williams and Royce 1982, 1983; Williams and Clarke 1984, 1995) have reduced the Belan formation into 7 units. Reddish sandy/silty formation and overlying silt are grouped together. The deposit overlying Gravel III is again reduced to two units instead of three.

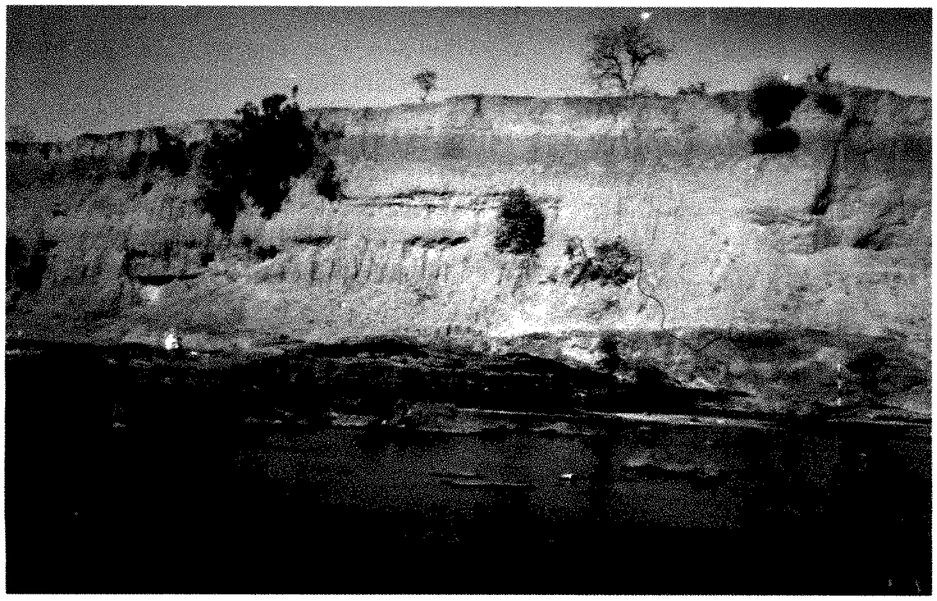

Fig. 2 Belan main section

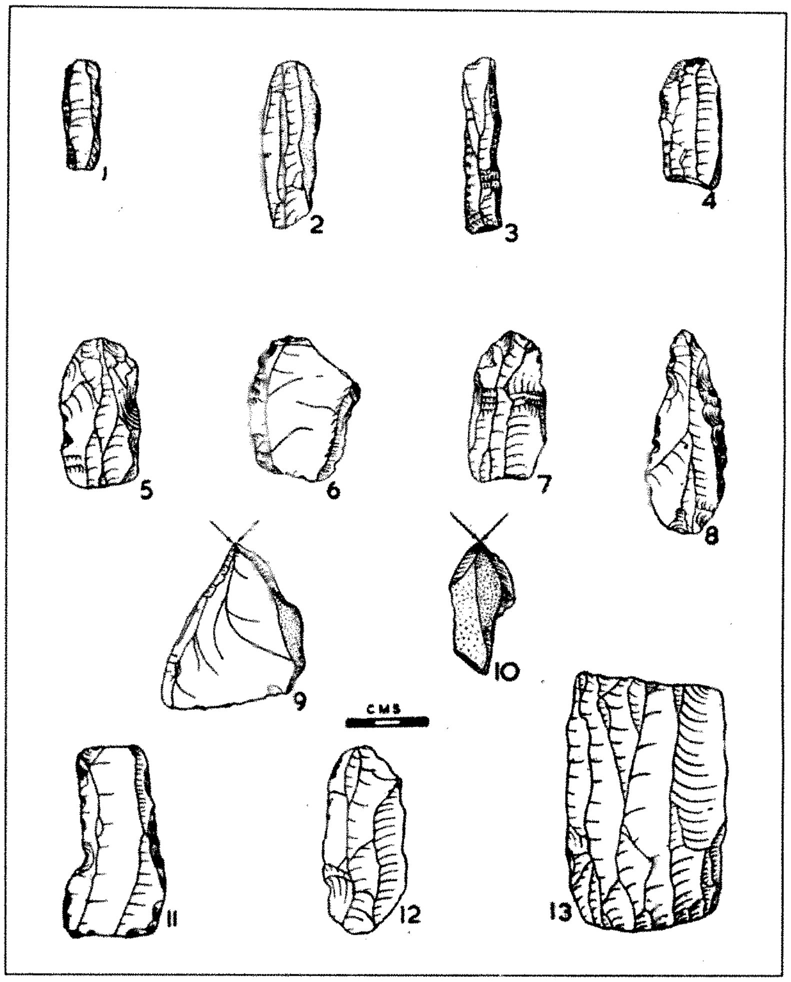

Fig. 3 Upper Palaeolithic tools from Belan Valley

With the exception of the calcareous brown clay loam resting on Gravel I, all the geological units of the Blean section are implementiferous (Sharma 1973: 106-10). Lower Palaeolithic tools have been obtained from Gravel I. Sub-unit II A of Gravel II has yielded evolved Lower Palaeolithic along with Middle Palaeolithic tools. Sub-units IIB and IIC contain Middle Palaeolithic tools. The succeeding formation of reddish brown sandy clays and the overlying yellow silt have also yielded Middle Palaeolithic tools but the artefacts obtained from the yellowish silt exhibit a transitional character. Along with Middle Palaeolithic tools, an Upper Palaeolithic facies is also met with in this formation. Gravel III has yielded Upper Palaeolithic tools. From the succeeding formation of black soil, Upper Plaeolithic tools (Fig. 3) along with non-geometric microliths were obtained. The overlying aeolian and sub-aerial deposits, the penultimate and the last formation recorded in the Belan section, contain non-geometric microliths without pottery and geometric microliths with pottery, respectively.

In the mid-Son Valley an extensive area covering a distance of over 70 km bounded by Kaimur in the north, and Son in the south was investigated by Martin Williams and Keith Royce working with Prof. Desmond Clark (Williams and Royce 1982: 139-62; 1983: 9-23; Clark and Williams 1986: 18-41; 1990: 120-133). The Son section, 30 m thick, reflects the behaviour of the river alternating between erosion and deposition divided into five geological formations in ascending order (Fig. 4). Three formations have been named after following type sites.

1. Sihawal Formation

The type section on the left bank of the Son, 1 km east of the Sihawal village, with a maximum preserved thickness of 1.5 m, rests on the eroded bed rock. It comprises angular to rounded clasts of sandstone, shale and quartzite ranging in size from sand sized grains to boulders up to 50 cm in diameter, set in the matrix of clay. The upper unit of this formation is well-sorted silty clay, grey/brown in colour and appears to be a wind-blown dust. The basal unit

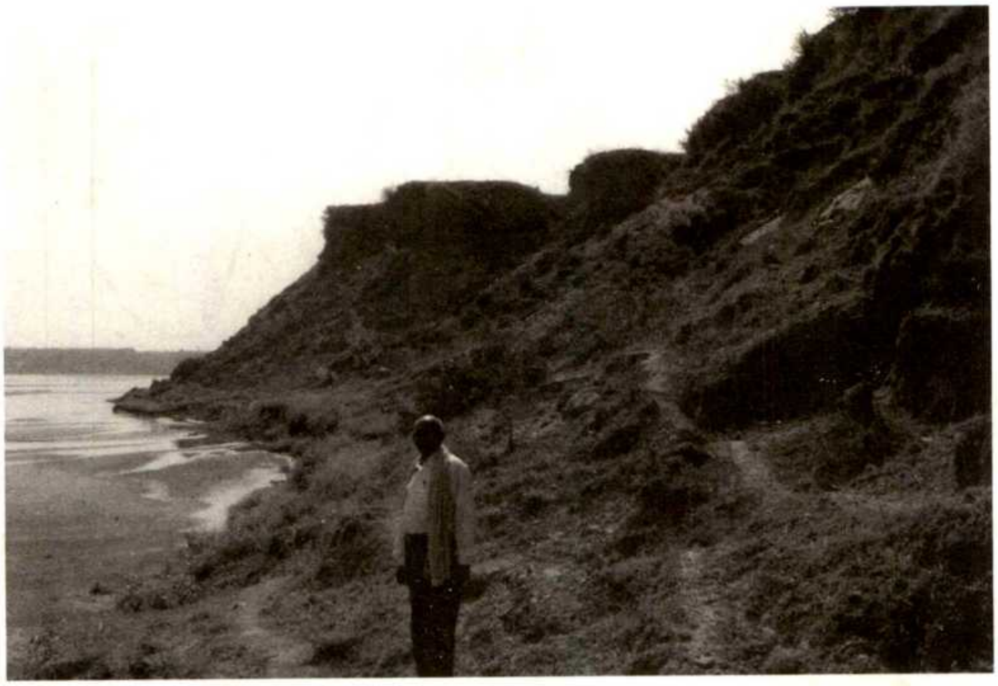

Fig. 4 Son section

of the Sihawal formation contains evolved Acheulian biface tools and flakes while the upper unit is entirely devoid of both gravel and artefacts.

2. Khunteli Formation

Martin Williams and his team have located a new geological unit on the right bank of the Son near the village of Khunteli. This formation has been placed between the Sihawal and Patpara formations. It comprises a basal unit up to 6 m thick, of pale yellow-brown unconsolidated medium sand, a discontinuous bed of pure volcanic ash up to 1.5 m, at least 4 m cross bedded and planner bedded medium and coarse sands and fine gravels and an upper unit of carbonate cemented gravels. The volcanic ash contained in the Khunteli formation was the first Quaternary ash discovered in India. Its source is the Toba volcano in Sumatra which erupted around 73±4 Ka ago.

3. Patpara Formation

With a maximum exposed thickness of 10 m, it unconformably overlies the Sihawal formation. It has a characteristic reddish colour and contains rounded to subangular clasts of quartz, sandstone and mudstone and it abounds in agate, chalcedony and other micro crystalline silica rocks. The bedding varies from massive to flat or undulating laminations. The formation is partly cemented by iron. In places it is overlain by 1 m of dark red/brown mottled silty clay. The formation is erosionally truncated by the overlying Baghor formation.

Evolved Acheulian and Middle Palaeolithic artefacts (Fig. 5) have been obtained from the Patpara formation. As the Lower Palaeolithic artefacts contained in the formation are fresh, it stands to reason that these have not been dislodged from older formations. In this respect the position of the lower part of the Patpara formation compares well with IIA of the Belan formation as far as the artefacts contained in them are concerned. Both formations have yielded Acheulian and Middle Palaeolithic tools side by side.

4. Baghor Formation

With a maximum exposure of 20 m this formation unconformably rests on the Patpara formation. It comprises two distinct members, each about 10 m thick, a lower coarse member and an upper fine member. The coarse member contains sheets of unconsolidated cross-bedded sands, ranging from 5 to 80 cm in thickness. It is composed of quartzite, shale, quartz, chalcedony, agate, chert, etc. ranging in size from medium to very coarse sand granules and pebbles. At places, this sub-phase is capped by a thin interval of inter bedded sands and silts. From this sub-formation, rolled and abraded Middle Palaeolithic artefacts along with fresh Upper Palaeolithic tools were obtained. The formation is highly fossiliferous having yielded remains of *Bos*, *Bubalus*, hippopotamus (Fig. 6), crocodile, antelope, elephant (Fig. 7), *Equus*, tortoise, etc. often in well-preserved conditions.

The fine member forms the highest aggadational surface in the Son Valley with an elevation of 30 m above

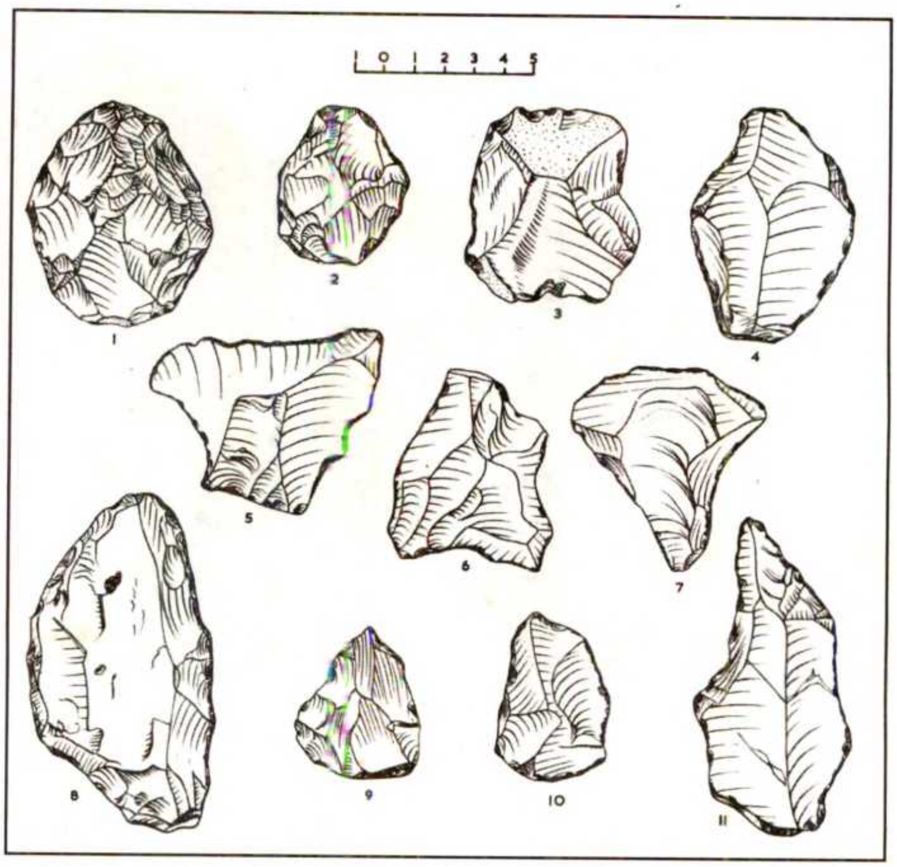

Fig. 5 Middle Palaeolithic tools from Son Valley

the water level and rests comformably on the coarse member with no evidence of any erosional break. The sub-formation consists of inter-bedded silts, clays and occasionally fine sands. The irregular calcium carbonate occurs throughout the deposit, though it is heavily concentrated towards the top. The sub-formation has yielded Upper Palaeolithic and Epipalaeolithic tools and microliths at different places indicating thereby that these industries flourished during the formation under question. The formation covered a long span of time.

5. Khetaunhi Formation

Composed of inter bedded silts, clays and fine sands, it has a thickness of 10 m. It is an aggradational terrace and during floods, the modern Son occasionally overtops this terrace. The Khetaunhi formation has yielded evolved microliths and Neolithic tools though from different horizons.

The influence of the Son was over a much wider area than that of the Belan, but as these two rivers are located almost in the same ecological zone, their respective formations exhibit a good deal of similarity. Correlations between the Belan and Son Valleys alluvial sequence are based on similarities in lithology and prehistoric artefact assemblages, checked against radiocarbon and IRSL dates. The boulder conglomerate (Gravel I) of the Belan is equivalent to the Sihawal formation of the Son. Mottled clay in both the valleys is correlated. The IIA (Gravel II) of the Belan is equivalent to the Khunteli formation. The reddish and yellowish formations of the Belan correlate with the Patpara formation of the Son. Gravel III of the Belan section can be equated with the Baghor formation (coarse member) of the Son section. The fine member of the Baghor formation may coincide with the brown and yellow brown calcareous clay lamps and sandy clays of the Belan unit associated with epipalaeolithic artefacts and microliths. In the Son valley, the Khetaunhi formation, the last geological unit, does not appear to have its counterpart in the Belan Valley since the said formation in the Son valley contains Neolithic material characterized by rounded celts, microliths, and hand-made pottery comprising corded, rusticated, burnished red, burnished black and occasionally crude black and red ware. In the Belan Valley, the debris associated with the Neolithic culture does not form part of any geological unit. It lies above the last geological unit.

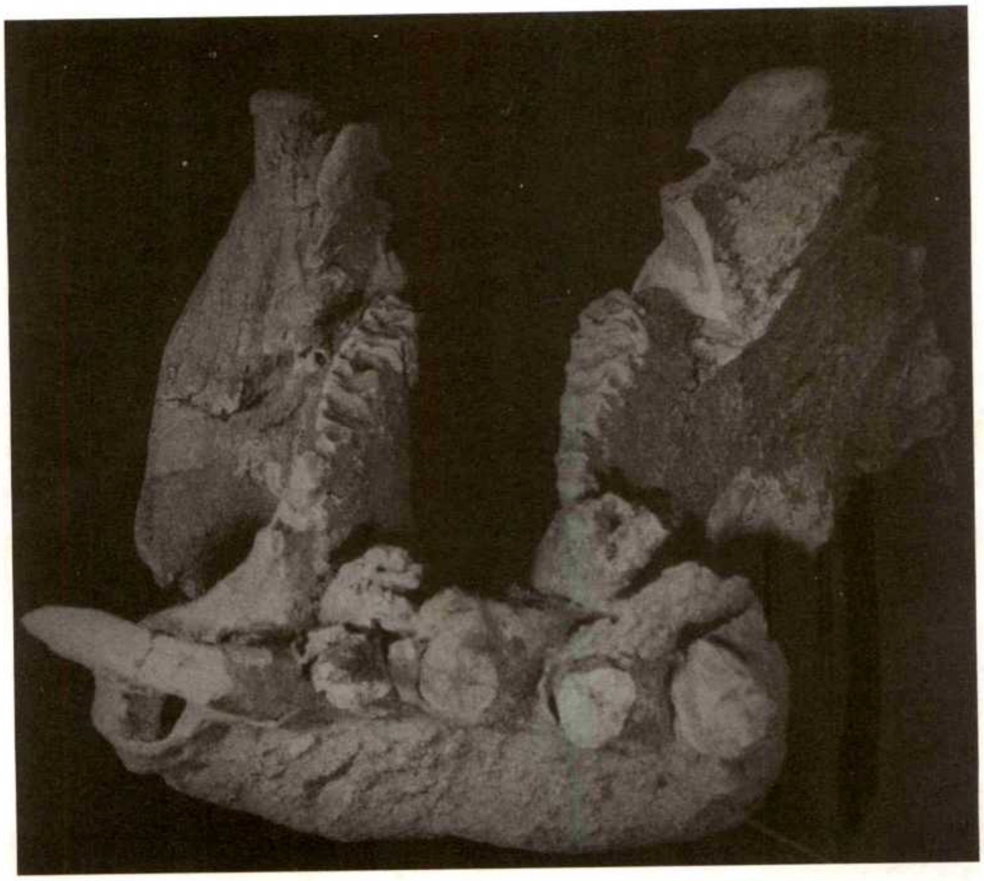

Fig. 6 Hippopotamus from Son Valley

III

The chronology of the Stone Age cultures in India is still unclear. Previously, dates were proposed on the analogy of Europe, Africa and South-East Asia. British archaeologists, working in the northwestern region of Pakistan have suggested a high antiquity to the early Sohan Culture on the basis of magnetic polarity stratigraphy. As per their claim, the earliest tools in the area can be dated to two million years ago (Rendell *et al.* 1987: 488-96; Dennell *et al.* 1988: 98-106). On this point the high antiquity, already suggested, of the pebble-tool cultures of Central Asia also deserves attention. However, in the Indian context, the co-occurrence of primitive and evolved tools from the same horizon has complicated the issue. At Bori near Pune, a volcanic ash underlying a gravel deposit containing Acheulian assemblage has been dated by potassium-argon method to 1.4 million years (Korisettar *et al.* 1989a: 135-138; Korisettar *et al.* 1989b: 564-567). Efforts are also on to date Acheulian sites by thermoluminescence (TL.), and U/Th decay series techniques (Misra 1989: 21). Dates obtained by these techniques from the sites of Umrethi in Saurashtra and Didwana in Rajasthan indicate that the Acheulian culture at these sites is older than two hundred thousand years. There is every likelihood that future research may place this culture somewhere between 2.0 to 0.7 myr ago. Lower Palaeolithic culture at Isampur is dated to 1.2 million years by electron resonance method, but in some areas the Acheulian tradition might have persisted even up to upper Pleistocene (Paddayya *et al.* 2002: 101).

From the North-Central Indian sites a few dates were already obtained from Upper Palaeolithic, Epipalaeolithic, Mesolithic and Neolithic horizons. Five dates obtained from Gravel III of the Belan section read 19715±330 B.P.; 18055±150 B.P.; 24430±350 B.P.; 25790±745 B.P. and 26270±660 B.P (Pal *et al.* 2004: 61-62). As these samples were obtained from Gravel III, it was argued that the antiquity of the Upper Palaeolithic culture in the Belan valley may be traced back to around 40000 B.P. because the deposit underlying the Gravel III also yielded Upper Palaeolithic tools. Two dates obtained from Rampur, an Upper Palaeolithic/Epipalaeolithic site in the Son Valley have readings of 20135±220 B.P. (Beta 4791) and 26250±420 B.P (Beta 4793).

Five dates obtained from Gravel IV at Mahagara have readings of 13740±400 B.P., 11550±180 B.P., 10980±190 B.P., 9830±160 B.P. and 9740±115 B.P. (Possehl and Rissman 1992: 460, Table 2) along with one date obtained from Baghor in the Son valley having a reading of

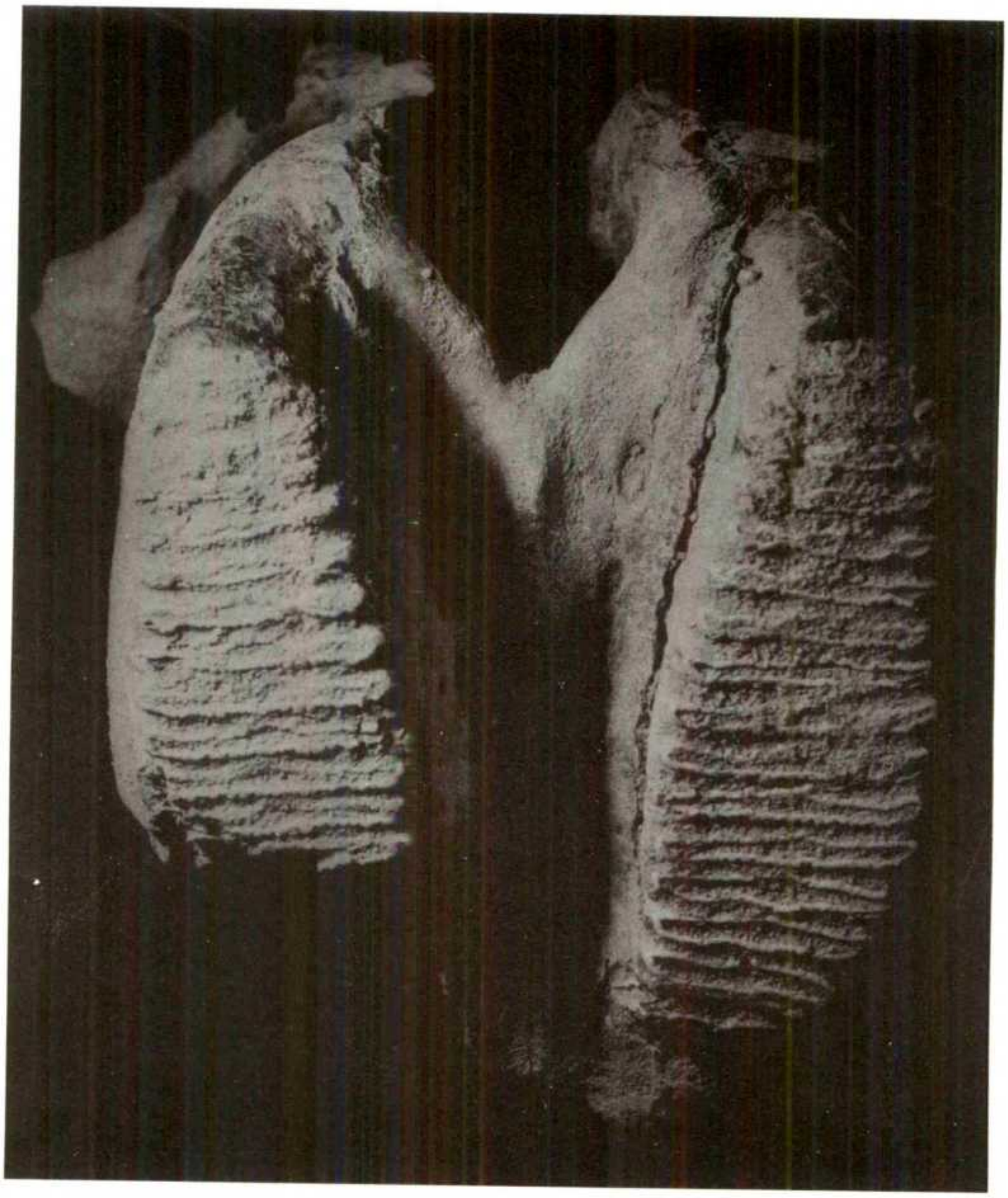

Fig. 7 Elephant jaw from So0n Valley

11870±120 B.P. (Pal *et al.* 2004: 62) provide an indication of the time-range of the Epi-palaeolithic culture of the Belan and Son valleys.

For fixing the chronology of the Mesolithic culture of North-Central India, three dates deserve special attention. From Baghor II in the Son Valley a date reading 6380±220 B.C. (Possehl and Rissman 1992: 461) was obtained. From Lekhahia Rock Shelter I in Mirzapur district two AMS ^{14}C dates reading 6420±75 B.C. and 6050±75 B.C. (Lukacs *et al.* 1996: 301-11) were obtained. These dates would indicate the emergence of the Mesolithic culture in the earlier part of the Holocene.

Supportive dates have been obtained from Barkhera (M.P.) and Adamgrah (M.P.) in the Vindhyan area as well as from Sarai-Nahar-Rai, Damdama and Paisra in the Ganga Valley. The date obtained from Barkhera reads 5520±130 B.C. (Possehl and Rissman 1992: 461, Table 3), and that from Adamgarh reads 5505±125 B.C. (Possehl and Rissman 1992: 461, Table 4). The date obtained from Sarai-Nahar-Rai reads 8395±110 B.C. (Possehl and Rissman 1992: 461, Table 4). A thermoluminescence date from Damdama suggests an antiquity of the Mesolithic culture at the site between 5000 B.C. to 7000 B.C. Two AMS ^{14}C dates obtained from the same site read 6690±65 B.C. and 6915 ±65 B.C. (Lukacs *et al.* 1996: 301-11).

From the Mesolithic Paisra in Bihar, a radiocarbon date of 7420±110 B.C. (Lukacs and Pal 1993: 745-65) has been obtained. These dates would place the beginnings of the Mesolithic culture in the Early Holocene.

Table 1: Stratigraphic units and ages of associated prehistoric cultures in the Belan and Son Valley

Name of Formation	River	Culture	Period
Sihawal Formation	Belan Units (a), (b)	Lower Palaeolithic	≥ 100 ka
Khunteli Formation	Belan Unit (c)	Middle Paleolithic	75 ka
Patpara Formation	Belan Unit (d)	Middle Palaeolithic	58-45 ka
Baghor Formation	Belan Unit (e)	Upper Palaeolithic	39-20 ka
Baghor Formation	Belan Unit (f)	Epi-Palaeolithic	20-16 ka
	Khetaunhi Formation	Belan Unit (f)	Microlithic 10-8 ka
	Khetaunhi Formation	Belan Unit (g)	Neolithic 6-3 ka

Until recently no dates were available from Lower and Middle Palaeolithic levels both in Belan and Son Valley. But fortunately Martin Williams has obtained seven IRSL dates (Table 1) from the Son and Belan Valleys to date the entire formation ranging from the Lower Palaeolithic to Neolithic (Pal *et al.* 2004: 62, Table 4). These dates are as follow:

From the dates in Table 1 the Lower Palaeolithic may be placed around 1,00,000 B.P., Middle Palaeolithic from 58,000 to 45,000 B.P., Upper Palaeolithic between 39,000 and 20,000 B.P., Epi-Palaeolithic from 20,000 to 16,000 B.P., Mesolithic from 10,000 to 8,000 B.P. and Neolithic between 6000 and 3000 B.P. The earliest date (100,000 B.P.) is assigned to the Lower Palaeoliolithic period. It is not unlikely that in future we may get even earlier dates from the Lower Palaeolithic horizons. As far as dates ascribed to the Middle, Upper and Mesolithic cultures are concerned, these are in consonance with dates obtained from comparable sites in different parts of India.

IV

The discovery of Neolithic implements in archaeological context in North-Central India is a recent event in Indian Archaeology. Neolithic celts fashioned on basalt had been collected from the hilly tracts of Lalitpur, Hamirpur, Banda, Allahabad and Mirzapur districts from time to time (Allchin and Allchin 1968: 172). Triangular celts, conforming to the characteristic tools types of South Indian Neolithic were the main tool types discovered in the area. Besides, a few rounded celts supposed to be characteristic tool type of the Neolithic culture of northeast India and farther afield of Southeast Asia were also met with. As these two tool types were known from surface collections and were occasionally found together regarding their respective chronological position three possibilities were raised:

1. Two distinct tool traditions represented by triangular celts and rounded celts coming from South India and Northeast India, respectively met together in the North-Central India. As such, these should be treated as contemporary.
2. The tradition of triangular celts coming from South India entered the North-Central Vindhayan area earlier than the rounded celt tradition.
3. The rounded celt tradition constituted a base over which the triangular celt tradition was superimposed.

Before excavations at Koldihwa, the consensus of archaeologists was in favour of the second possibility. However round celts were obtained in the course of excavations, in a definite archaeological context not only from Koldihwa (Misra 1977: 107-119; Misra 2006: 143-81) but also from Mahagara and Panchoh (Sharma *et al.* 1980: 135-36) in the Belan Valley in Allahabad district from Indari (IAR 1980-81: 71), and Tokwa (Misra *et al.* 2000: 45-57; Misra *et al.* 2000-2001; 59-72) in the Adwa Valley in Mirzapur district of U.P. and from Kunjhun (IAR 1981-82: 43-44) on the Son in Sidhi district of M.P. Their high antiquity is suggested both by their context and ^{14}C dates. It deserves to be noted that none of the excavated sites mentioned above has yielded triangular celts so far. The available evidence would thus suggest a greater antiquity to the rounded celt tradition in comparison to the triangular celt tradition in North-Central India.

Taking into consideration the distinct personality of the Neolithic culture of North-Central India which emerged from excavations at Koldhiwa, planned archaeological investigations were carried out in the area concerned over last two decades by the Department of Ancient History, Culture and Archaeology, University of Allahabad for discovering more Neolithic sites. The explored area lies between 24° and 28° 30' N and 80°-84° E. It is roughly bounded in the north by the Ganga and in the south by the Son. The explored sites are located in the valleys of the Belan, Adwa and Son. The important sites are Koldihwa, Mahagara, Panchoh, Kukrahta, Deoghat, Koilariha, Futaha,

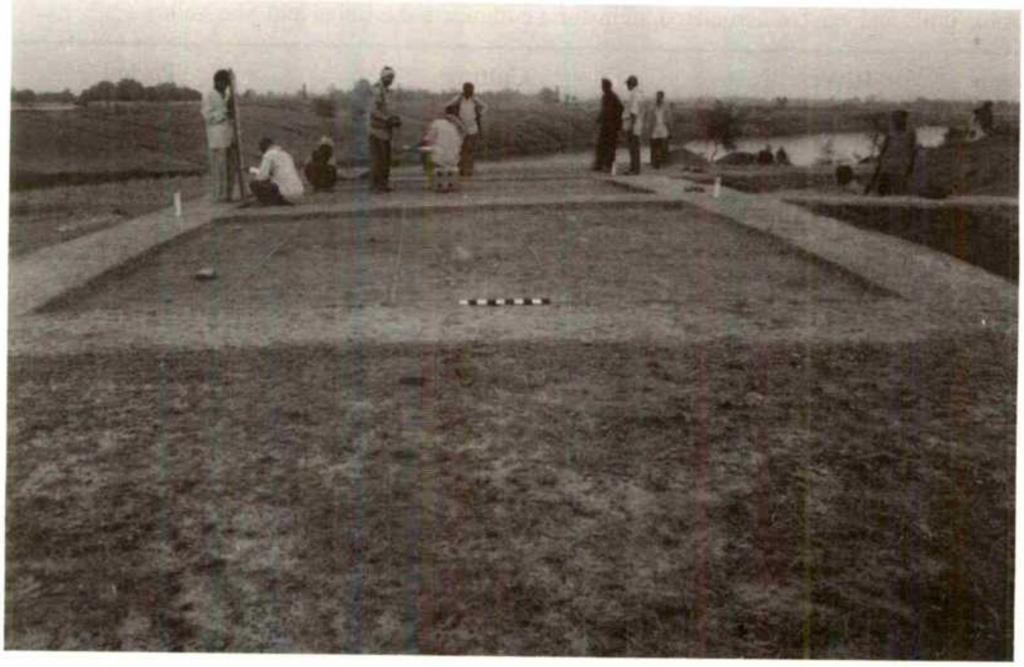

Fig. 8 Tokwa: general view

Mahagara have thrown welcome light on the range of cereals cultivated by the Neolithic people of North-Central India. Crops identified at Koldihwa and Mahagara included rice, barley, wheat, pulses, sesame and small millets. The available evidence suggests that both at Koldihwa and Mahagara, wild and cultivated varieties of rice and small millets were used from the beginning of the Neolithic settlements. Barley, wheat, pulses and sesame were introduced at these sites subsequently. From Tokwa, K.S. Saraswat (personal communication) has tentatively identified rice, wheat, barley, green gram, lentil and small millets. According to his preliminary observation, Neolithic people were cultivating rice and small millets in the beginning but with the passage of time they also started cultivating barley, wheat, green gram, lentils etc. Supportive evidence has also been obtained from Senuwar in the Rohtas district in Bihar (Singh 2001: 109-118). The Neolithic deposit at the site is divided into two subgroups 1A and 1B. From the lowest part of the middle of period IA only grains of cultivated rice, (*Oryza sativa*) were found. Along with this, the settlers also utilized wild plants, like jobs tear, fox tail/bandra, wild rice, jharberi, chaulai and wild palaka. But in the later phase of IA there appears to have been a shift in the economy with the introduction of new cereals like barley, wheat, *jowar*, millet, lentil, field pea, finger millet/ragi and khesari. The available evidence suggests that by the late phase of the Neolithic culture, these cereals had started playing a major role in the life of the people.

The range of cereals cultivated by the Neolithic people of North-Central India raises some interesting issues. Cultivated cereals whether falling in the category of Kharif (summer) or Ravi (winter) crops were adopted from wild grasses. Stone Age man had started gathering seeds of these grasses for consumption. This would indicate that the first cultivation of any cereal would have taken place only in that area where its wild prototype was available. Viewed against this background, one finds the distribution of wild rice over a wide area comprising eastern India, South-East Asia and South-Western China (Chang 1976: 143-157; Chang 1989: 408-17; Singh 1991: 39-58). The distribution of wild barley, wheat, lentil etc. on the other hand is recorded from the border of Pakistan, Afghanistan to Iran, Levant, Turkey, etc. (Moore 1982: 225-36; Moore 1989: 620-39; Singh 1991: 1-16). This would suggest that rice and possibly small millets were available in wild form from North-Central India, before these were cultivated. But wheat, barley, etc. would have been introduced into this area only when people of the area came into contact with the people of North and North-Western India. Neolithic sites of the Indian subcontinent like Mehrgarh and also at mature Harappan sites would suggest that in the earlier stages of agriculture, North-western India was not acquainted with rice, cultivation and acquired its knowledge from north-central India. In the same way north-central India was not acquainted with the knowledge of barley, wheat, lentil, etc. and would have got this knowledge from North-western India. This would have been possible only through contact between inhabitants of both areas.

The roots of the Neolithic culture of North-Central India appears to lie in the pre-Neolithic culture of the area. In this connection, the excavation at Chopani-Mando (Sharma *et al.* 1980: 33-76), on the old Belan, in Koraon

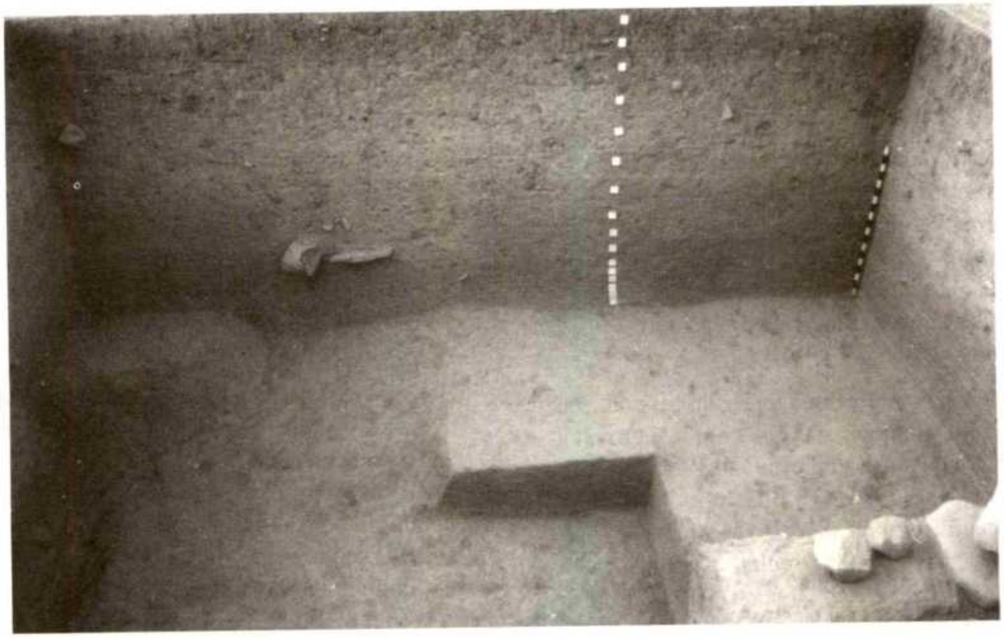

Fig. 9 Tokwa section

sub-division of Allahabad, deserves attention. This site is situated at a distance of only 3 km from Koldihwa and Mahagara. A habitational deposit measuring 1.55 m was exposed at the site, and it has been divided into three phases. Phase I Epi-Palaeolithic, Phase II Mesolithic and Phase III advanced Mesolithic or proto-Neolithic. The last phase is characterized by hand-made pottery, introduction of some new tool types like the isosceles triangle and tranchets, and plans of hutments, hearths, along with food processing equipment like querns and mullers, anvils and hammer stones, and ring stones. Burnt clay lumps with reed impressions suggest wattle and daub structures. Remains of wild rice were also found embedded in burnt clay lumps with reed impressions. The presence of wild rice, however, when viewed in the context of the presence of food processing equipment and other traits of semi-sedentary settlements would suggest its collection during this phase. The appearance of hand-made pottery in this stage at Chopani-Mando and all the excavated Neolithic sites, offers another linkage between the two. The first occurrence of the tranchet during the proto-Neolithic phase of Chopani-mando on the one hand and its recurrence at Koldihiwa, Mahagara and Panchoh on the other would also suggest continuity between the Proto-Neolithic and Neolithic. A transition from gathering of wild rice to its cultivation is also indicated. As regards domestication, inter-linkage between the proto-Neolithic and Neolithic is also suggested. The occurrence of wild sheep, goat and cattle is recorded from Gravel III, Gravel IV and in the late Mesolithic phase at Chopani-Mando. During the Neolithic phase we find these animals domesticated. The microlithic component of the Vindhyan Neolithic culture also constitutes a running theme from the Mesolithic to the Neolithic. These pieces of evidence put together would suggest a local origin of the Neolithic culture of North-Central India. Its evolution from the underlying Mesolithic culture is indicated.

Any enquiry pertaining to the beginning of agriculture in North-Central India is intertwined with the chronology of the Neolithic culture of the area. For establishing the chronology of the Neolithic culture of North-Central India both archaeological data and ^{14}C dates are available. Even then, one has to admit that the final script on the topic is yet to be written. While discussing the archaeological data on this point the following facts need attention:

(1) In North-Central India transition from late Mesolithic to Neolithic is documented. We start getting evidence of quasi-sedentary settlements during the late Mesolithic period characterised by the presence of hutments, food processing equipment and occasional hand-made pottery. Collection of wild rice is also attested to.

(2) There is a continuity between the late Mesolithic and Neolithic as regards the construction of hutments, use of food processing equipment, hand-made pottery and use of microliths. Though evidence of domestication has not been found from any of the excavated Mesolithic sites of North-Central India, it is not unlikely that such evidence may be obtained in future as it has already been found at Bagor (Misra 1989: 34-37) in Rajasthan, Adamgarh (Joshi 1989: 1-3) in Madhya Pradesh; and Loteshwar and Ratanpura in Gujarat (Bhan 2004: 94-103).

(3) Collection of wild rice during the late Mesolithic phase and cultivation of *Oryza sativa* in the Neolithic phase also indicates a transition from gathering to cultivation.

(4) All excavated Neolithic sites of North-Central India are characterized by hand-made pottery, absence of metal, and a limited number of bone tools. This would suggest that these people heavily depended on stone tools, whether microliths or heavy duty tools. The points, cited above, would indicate the primitive character of the culture.

Of the six excavated sites in the area under discussion, four (Koldihwa, Mahagara, Kunjhun and Tokwa) have provided ^{14}C dates. From Koldihwa three dates reading 4530±185 B.C., 5440±240 B.C. and 6570±210 B.C. have been obtained (Possehl and Rissman 1992: 461). Mahagara has provided us with six dates, two thermoluminescence and four ^{14}C dates. The TL dates read 2265 and 1616 B.C. The ^{14}C dates read 1400±150 B.C., 1330±120 B.C. 1440±100 B.C. and 1480±110 B.C. (Possehl and Rissman 1992: 461). Three calibrated dates from Kunjhun river-face read 1565-1265, 2665-2675-2575 and 3530-3335 B.C. (Possehl and Rissman 1992: 473-74). In the light of these dates Possehl and Rissman have proposed a time-bracket of 4000 to 1200 B.C. for the Neolithic culture of North-Central India. Recently three ^{14}C dates have been obtained from Tokwa. When calibrated these read 6591 B.C. (BS - 2417), 5976 B.C. (BS - 2369), 4797 B.C. (BS – 2464). In the light of these dates the antiquity of the Neolithic culture of North-Central India may be traced back to the 7th millennium B.C. Supportive ^{14}C dates from the Neolithic horizon have also been obtained from two sites of the mid-Ganga Valley. From the Neolithic horizon of Jhusi on the confluence of the Ganga-Yamuna in Allahabad, three C^{14} dates have been obtained. These dates when calibrated, read 7477 B.C. (BS – 2526), 5837 B.C. (BS – 2524) and 6196 B.C. (BS – 2525). The earliest date obtained from the site would put the beginning of the Neolithic culture of the site in the 8th millennium B.C. From Lahuradeva (Tewari *et al.* 2003: 55-56), a multi-culture site in Sant Kabir Nagar, two ^{14}C dares read 5320±90 B.P. (Cal. B.C. 4220, 4196 and 4161) and 6290±160 B.P. (Cal. B.C. 5298). An AMS C^{14} date for carbonised domesticated rice would push the antiquity of the Neolithic culture at the site to the 7th millennium B.C. (Tewari *et al.* 2005: 40).

The combined testimony of the available ^{14}C dates from Koldihwa and Tokwa in North-Central India and Jhusi and Lahuradeva in the middle Ganga plain would push the antiquity of Neolithic culture in North-Central India and the middle Ganga plain to around the 8th millennium B.C. These, read along with the date obtained from Mehrgarh (Jarrige and Lechevallier 1979: 463-535; Jarrige and Meadow 1980: 122-133; Shaffer 1992: 436, Table 3) in Baluchistan, would suggest the existence of two regional centres for the beginning of agriculture in the Indian subcontinent. One centre was developing in the North-West with barley and wheat as major crops; the other was developing in the North-Central India and the Middle Ganga Plain with rice and small millet as main cereals. With the passage of time there was a dialogue between west and east as a result of which rice travelled to the west and barley, wheat, lentil, etc. were introduced to North-Central India and the Middle Ganga Plain.

To sum up, the region of North-Central India appears to have played a crucial role in the history of man in India. The area was inhabited by man right from the mid-Pleistocene onwards. It was a witness to the evolution of human culture from the Lower Palaeolithic to the Neolithic. The geological units of the Belan and Son have also recorded climatic fluctuations which the area underwent through the ages. A systematic exploration in the area has brought to light thousands of animals fossils, thus putting the area on the fossil map of India. All the geological units have been dated. The area, under discussion, also played a crucial role in origins of agriculture. Available evidence suggests that the Neolithic culture of the North-Central India evolved from the late Mesolithic with which it shares a number of traits. The regional character of this Neolithic culture is fully established. The high antiquity of the culture is indicated both on the basis of archaeological evidence and available ^{14}C dates. There is reason to believe that in the Indian subcontinent there was more than one centre, where agricultural practices were initiated. North–Central India has the credit of being one such centre. Though the final script on the topic is yet to be written, available evidence is encouraging. Further excavations at Tokwa, in North-Central India, and Jhusi and Lahuradeva in the middle Ganga plain, are urgently needed, and these excavations should be multi-disciplinary in nature.

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Shobhana Gokhale, *Man and Environment* XXXII(1): 15-22 [2007].
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The Buddhist Literary Traditions as Reflected in Western Indian Cave Inscriptions and Architecture with special Reference to Kanheri Caves*

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Abstract

There are more than twelve hundred rock-cut caves in western India. Inscriptions and architecture therein restored the rhythm of religion and embodied the ethos of literary traditions. If we investigate the reason behind the remarkable grandeur and meaningful monotony in Buddhist architecture, we find that there is a beautiful synchronism between the Buddhist literary traditions, religious concepts and the then social psyche. It is therefore necessary to study Buddhist architecture against the backdrop of Buddhist literature.

The canvas of Buddhist literature has preserved human values and lessons for common people, at the same time Buddhist texts have offered an excellent basis for understanding the real spirit and merits of architecture. The inscriptions in caves are not mere records of donations but they pulsate with the main force of the Buddhist religion.

The Buddha converted a large number of people from different social sectors. Initially Bhiksus dwelt in woods, at the foothills of mountains and wandering here and there. The Blessed-one allowed Bhiksus to dwell in huts and caves. Whenever the Bhiksus faced difficulties they approached the Blessed-one. The Blessed-one provided solutions, which were put into practice. In the course of time the solutions were codified and then they were turned into religious norms; and then practice became precept.

So far, the architecture of Kanheri has been studied by different scholars, but the literary tradition was not taken into consideration.

Kanheri which is mentioned as Krsnagiri in inscriptions, is 10 km to the south-east of Borivali, a suburb of metropolitan Mumbai (Maharashtra). In the entire network of Buddhist caves in western India, Kanheri had a distinct character. It was the biggest Buddhist establishment. It has been mentioned as *Krsnagiri Maharaja Mahavihara* in the 9th century inscription at Kanheri. Kanheri was modelled like a Jetavana monastery. In the *Mahavagga* and the *Chullavagga* we get the information regarding the dwellings of Buddhist monks and their architecture. Against this backdrop the settlement pattern of the Kanheri monastery could be studied. The excavation of caves and architecture concur with the norms mentioned in the *Chullavagga*.

Introduction

I am extremely thankful to the members of the Executive Committee and the General Body of the Indian Society for Prehistoric and Quaternary Studies for electing me to deliver the Late Prof. H.D. Sankalia Memorial Lecture. It is indeed my great fortune to have an opportunity to pay my homage to the sacred memory of my Guru. He was a world-renowned prehistorian. But if you see the list of the scholastic merits of Prof. Sankalia, you will find that basically he was a Sanskrit scholar who was awarded the prestigious Bhagawanlal Indraji Prize for Sanskrit in the M.A. Examination in the Bombay University. His subject for Ph.D. was the Archaeology of Gujarat. He had a genuine interest in all branches of archaeology, viz. epigraphy, numismatics, architecture, iconography, and therefore he contributed to almost all these subjects.

When we went with him for fieldwork he always said that an archaeologist must have a general knowledge of all the branches of archaeology, even though he or she may specialize in a particular branch. Because I followed this advice, I discovered a fine Neolithic axe at Narayana Chincholi near Pandharpur, some microlithic tools on the banks of the river Wardha in Vidarbha, and one Acheulian tool in the sand which was brought for the building construction near my house in Pune in Maharashtra,. This is my humble contribution to prehistoric archaeology which is recorded in the pages of *Indian Archaeology A Review* (IAR 167-68: 35).

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* H.D. Sankalia Memorial Lecture delivered at the XXXIV Annual Conference of the Society held at Gwalior (4-7 December 2006)

There are more than twelve hundred caves in western India. Inscriptions and architecture therein have restored the rhythm of religion and embodied the ethos of literary traditions. If we investigate the reason behind the remarkable grandeur and meaningful monotony in Buddhist architecture we find that there is a beautiful synchronism between Buddhists literary traditions, religious concepts and social psyche. It is therefore necessary to study Buddhist architecture against the backdrop of Buddhist literature.

The period ranging from the first century B.C. to the second century A.D. was the one of remarkable progress in trade and industry in western India. This was the time when the western coast of India witnessed the growth of brisk trade with the Roman Empire. Sopara, Kalyan and Chaul were flourishing ports and thus the western coast was humming with trade activities and simultaneously the religious dignity of Buddhism dominated the entire western coast. With flourishing trade there was the efflorescence of cultural activities. The architectural splendours of Buddhist caves show that the architects created a paradise, at the same time they meticulously retained architectural norms uttered by the Blessed-one. During the time of Vassavasa (four months of rainy season) the spiritual thoughts of Buddhism literally percolated into caves along with the trickling of the monsoon rains.

Kanheri which is mentioned as Krsnagiri in inscriptions is 10 km to the south-east of Borivali, a suburb of metropolitan Mumbai (Maharashtra). It is not far from the ancient rich ports of Sopara, Kalyan and Chaul. In the entire network of Buddhist caves in western India, Kanheri has a distinct character. It is not merely because of the proximity of the ports, like Sopara or Kalyan, but because the king Asoka encouraged a religious atmosphere by erecting a stupa and rock edicts at Sopara (Hultzsch 1989:118). Asoka's liberal attitude and goodwill towards all, made a deep impact on the religious as well as political environment of the western coast Kanheri enjoyed royal patronage from 250 B.C. to the 9th century A.D. The Vihara at Kanheri is mentioned as Maharaja Mahavihahara in the inscription of the Shilahara king Kapardin dated S 799 = A.D. 877 (Gokhale 1991: 70-71).

It is well-known that the rich merchant Anathapindaka purchased land for the Jetavana monastery from Jeta, and constructed a large monastery at Sravasti where there were dwelling rooms, retiring rooms, benches, service halls, bathrooms (Nhanapodhi), ponds, open-roof sheds (*mandapa*), store-rooms (*Kodhis*), *Upathanashala*, water-tanks (*Udapanashala*), etc., under the supervision of Sariputra. Kanheri was modelled like the Jetavana monastery, where along with all the above mentioned amenities, there existed a cemetery and toilets. The stupa of Sariputra in front of the Chaitya symbolically suggests his presence. In *Mahavagga* and *Chullavagga* we get the information regarding the dwellings of the monks (Max Müller 1965). Against this backdrop the settlement pattern of Kanheri monastery could be studied. The monastic establishment at Kanheri reveals that the excavation of caves and architecture concur with the norms mentioned in the *Vinaya Texts*.

The selection of the site of the monastery was entrusted to the Sangha. The site was selected by resolution of the Sangha, and was called as *Kappiya Bhumi* (Max Müller 1965: 120). The Blessed-one allowed Bhiksus five kinds of dwelling places (Max Müller 1965: 119): (1) Addhyayoga, (2) Pasada, (3) Hammiya, (4) Guha, (5) Pankalenani. The dwelling place of a Bhiksu (Guha) was of one *Sugata Vitasti* – Buddha's span 1.80 x 1.90 m. The monks used to sleep on mats. Mats were eaten by white ants and mice. Therefore, the Blessed-one allowed the carving of solid benches against the wall. The height of the bench was three *sugata angulas*. One *sugata angula* is equivalent to three ordinary *angulas*. The height of the bench in the cave was not more than 50 to 60 cm (Pachitiya 8.7). The breadth of the bench in the cave was not more than two feet. The Blessed-one made a rule that a Bhiksu should sleep in *Simha-Sayya*. The other bench in the cave was to be excavated with the permission of other Bhiksus.

The inner chambers were of four kinds: (1) Sivika-gabha (palanquin-shape), (2) nalika-gabha (barrel-shape), (3) Hammiya-gabha (upper-storeyed building), (4) Chatu-rassa-gabha (quadrangular hall) (Chull. VI.3.3.174).

The windows were of three types: (1) Vedika Vatapanam (Vedika-railing), (2) Jala Vatapanam (lattice window), (3) Salaka Vatapanam (windows with slips of wood) (Chull. VI.2.2.163). The Blessed-one gave instructions about doors, keys, and blind windows. The Blessed-one allowed Bhiksus to plaster the walls and to erect wooden balustrades (Chull. V.1.16, V.14.4, p. 96).

In the course of time the wooden ribbing was changed into stone. This was not a mere imitation of the Mauryan wooden tradition, but a meticulous observance of the Buddha's instructions. In all Buddhist caves in western India, these Buddhist literary traditions have been meticulously observed. Krsnagiri Maharaja Mahavihara is the biggest Buddhist establishment in Western India.

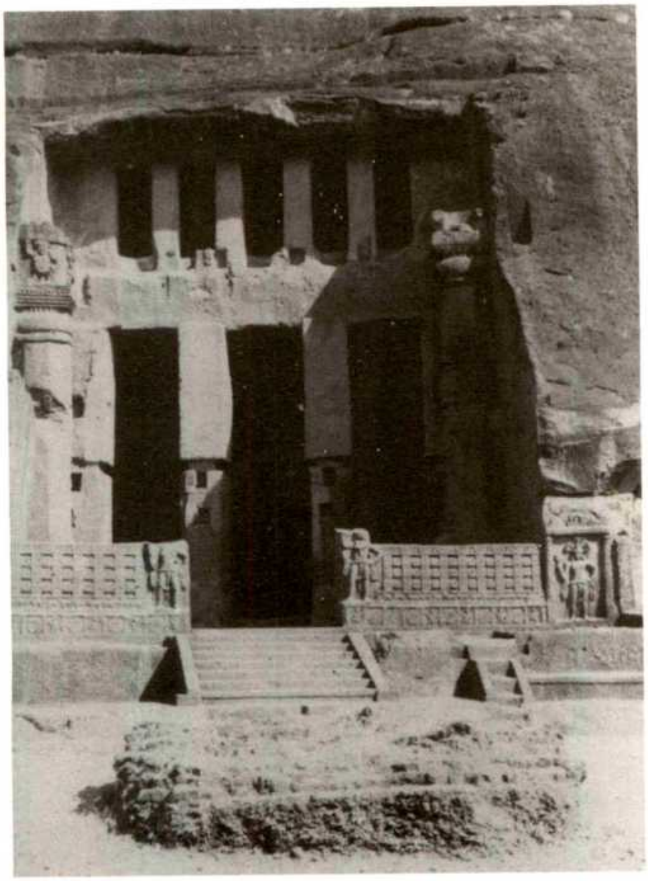

Fig. 1 Chaitya cave at Kanheri

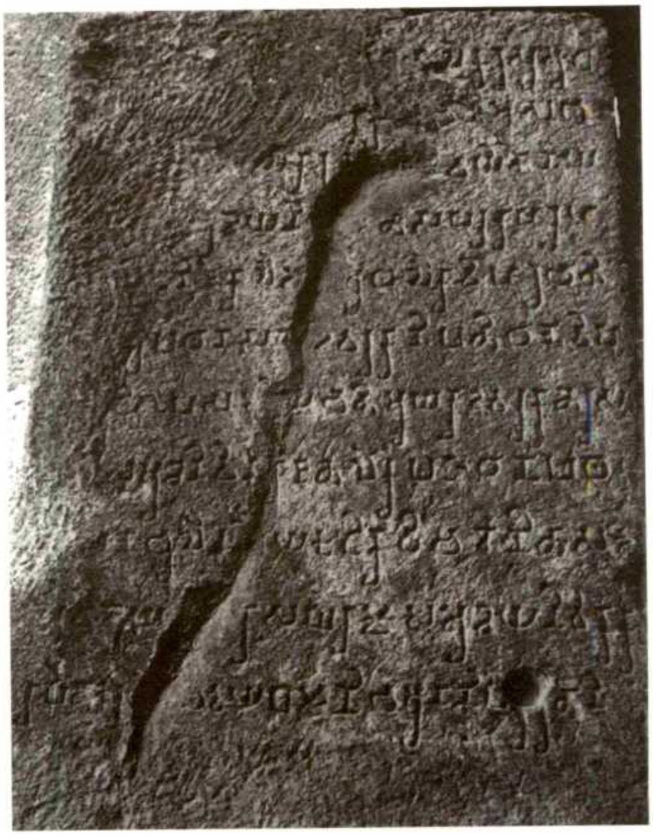

Fig. 2 Brahmi inscription

The *Mandapas*, seats, and coaches show the development of architecture. They were in the possession of the Sangha for the use of superiors (Chull. VI. 7.1, 189). The different teachers of *Abhidhammapitaka* were *Tevijja, Sakadagam, anagami*, and *sadabhijnani* monks.

The cave no. 1 is the only storeyd cave, which may be the 'Adhyayoga' where the monks of the Sangha resided. Cave No. 2 was a dining hall. The inscription therein records the donation of alms by a person named Nakanaka from Nasik (Gokhale 1991: 47).

The chaitya cave was constructed during the reign of the Satavahana king Gautamiputra Yajnasri Satakarni (2nd century A.D.). It was excavated by two merchant brothers, Gajasena and Gajamita, for the elders of Bhadrayaniya sect. The entire building activity of construction is recorded in a Brahmi inscription on two pillars at the entrance of the Chaitya cave. The inscription has recorded interesting architectural terms: (1) *Uparakhita* (overseer), (2) *Selavadhaki* (stone mason), (3) *Kadhichaka* (artisan), (4) *Mahakataka* (great worker), (5) *Mithika* (polisher), (6) *Navakarmika* (supervisor of the new additional work). *Navakarmika* was not merely a supervisor. He had to see whether the work was constructed and completed according to the norms mentioned in the *Vinaya Text*. In *Chullvagga* (Cull.VI.17.1.214) the time-span of the completion of different buildings has been prescribed. *Navakarma* was to be completed within five to six years and therefore the inscription mentioned two important technical terms: *Patithapita* (started) and *Samapeti* (completed within the prescribed period).

It seems that the building activity was entrusted to four Bhiksus, *viz*., Thera Bhadanta Achala, Gahala, Vijayamita, bhadant Bodhika and Dhammapala. It was the responsibility of these Bhiksus to complete the work. Failure in this duty was considered a severe offence (Gokhale 1991: 50).

In *Chullavagga* (VI. 17.1.214) the time-span of completion of different buildings was described. *Navakarma* should be completed within five to six years and Adhyayoga (double-storey) within seven to eight years. Prasada should be completed within ten to twelve years (Chull. VI.14.1.208). Walter Spink (1992: 177-192) opines that the Vakataka caves at Ajanta must have been completed within a period of ten to twelve years. This proposition could be examined with the help of *Vinaya Texts* (Figs. 1-2).

Immediately in front of the Chaitya cave there are remains of a dilapidated brick stupa. In 1839, James Bird discovered a copperplate dated K.245 = A.D. 494-95 (Gokhale 1991: 59). It states that the monk Buddharuchi who hailed from the Sindhu-Visaya erected the Chaitya

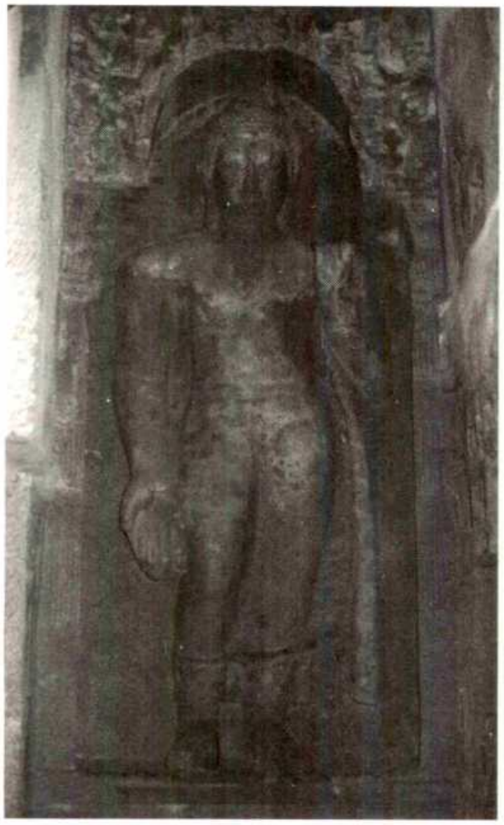

Fig. 3 Kanheri: Colossal Buddha

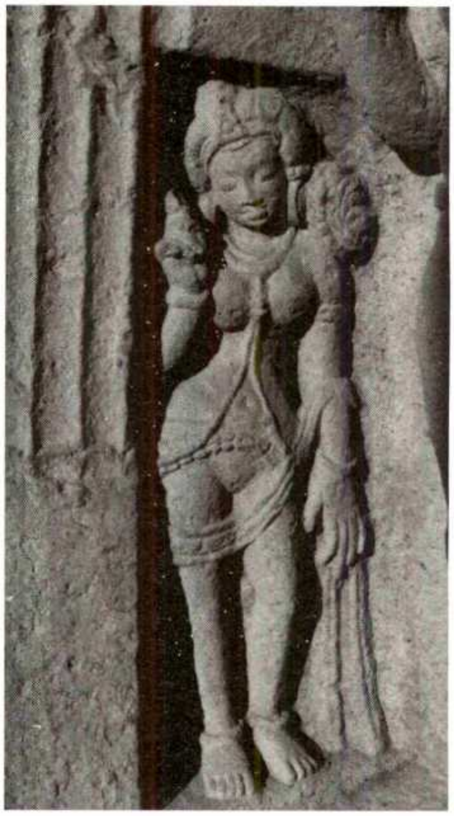

Fig. 4 Kanheri: Dipatara

with dressed stones and bricks. It was dedicated to the venerable Saradvatiputra (Sariputra), a highly intelligent disciple of the Buddha (*Mahapranavanta*) and he advocated *Abhidhamma pitaka*. The Jetavana Monastery was supervised by Sariputra. In the Krsnagiri *Maharaja Mahavihara* which was modelled like the Jetavana monastery there is a symbolic representation of Sariputra in front of the Chaitya. This is the superb synchronism between the literary, epigraphical and architectural evidence. It further suggests that till the end of the 5th century, Kanheri was the centre of the Hinayana pantheon.

In the Chaitya cave there are two colossal Buddha figures at the two ends of the verandah. The height of the Buddhas is twenty-two feet and they are shown in the 'Varadamudra'. They display a dynamic compositions and powerful rhythm (Fig. 3). If we observe these figures, one experiences a spiritual luminosity. *Dighanikaya* (Kasyapa 1958: 110) has mentioned thirty-two signs of great men. The artist at Kanheri incorporated these canonical marks. These are the only colossal figures of the Buddha in India. There is one inscription in the Chaitya cave which records the donation of the standing Buddha figure by the Sakya-Bhiksu Buddhaghosa, the guardian of the *Mahagandhakuti* which is same as the Gandhakuti at Ajanta. Inscriptional as well as sculptural evidence indicate vigorous Mahayana activity at Kanheri.

In the history of the progression of Buddhism at Kanheri, one notes the development of the Vajrayana Cult. There is a beautiful sculpture of Dipatara in the Chaitya cave. She is shown as the companion of Avalokitesvara, her measurements are as follows:

Height	73 cm
Breadth	21 cm
Waist-line	8 cm
From Waist to feet	43 cm
Face (including *Mukut*)	15.5-8 cm

This is an elegant figure of Tara, holding a full-blown lotus in her left hand and a torch in her right hand, benign, exhibiting the superb sense of plastic art. The moon-digit conspicuously shown on her hair chignon further suggests her role as the guiding star of navigation. This form of Dipatara is the only example of Tara so far noticed in western India. *Sadhanamala* (Bhattacharya 1949: 38) describes Dipatara as follows:

L.1 Paschime dipatarancha
Dipayashti Karankule

L.2 Pitavarna mahabhusam
chalat kanakakundlam

"Dipatara, the goddess of the west carries in her hand a torch. She is of yellow complexion, profusely ornamented and has swinging golden ear rings."

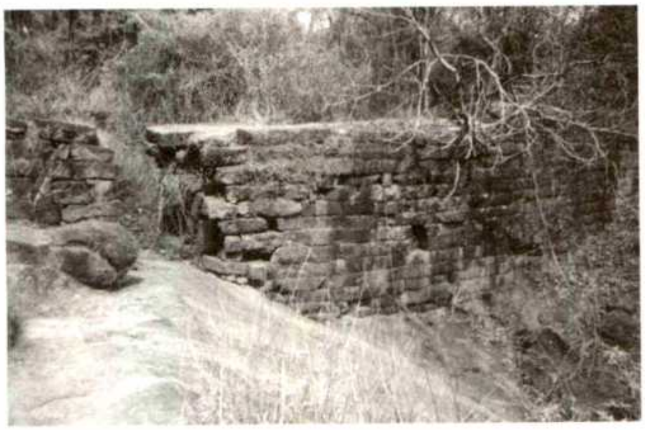

Fig. 5 Kanheri: Remains of a dam

the Chaitya cave has a graceful Vedika pattern frontage where a frieze of double-humped Bactrian camels is portrayed. It further suggests cultural relations between Kanheri and Central Asia.

The magnificent Chaitya cave at Kanheri in western India has embodied the ethos and progression of Buddhism, i.e., Hinayana, Mahayana and Vajrayana cults. It is the lithic encyclopaedia of Buddhist activities (Gokhale 2005: 5-15).

For such a large establishment there was an extraordinary water management system. The caves have a channel on the top to collect rain water. There was a catchment area and the inscription has recorded the construction of a water reservoir (Chull. V.17.1, 114). There are remains of a wall and a channel for the reservoir. This is the earliest archaeological evidence of dam construction in western India. On top of the caves there are channels to collect rain water in the tanks (*Podhis*) of the caves (Fig. 5).

The large staircase in stone is not meant only to ascend the hill or as an approach road to other caves. In Buddhist religion steps are known as '*chankama*'. The architectural term '*chankama*' does not merely mean a staircase but it is the path where Bhiksus could perform '*chankama*' in the evening and meditate (Chull. VI.14.2.103).

According to the legend of *Nidanakatha* (J.1.77) the Buddha after his enlightenment built for himself between the Bodhi tree and '*Animisachetiya*' a *chankama* of jewels running from the west to east on which he walked up and down for a period of seven days. When visiting Kapilavastu the Buddha created by magic a *chankama* in the air on which he performed '*Yamakapatiharya*'. It is interesting to note that the sculpture of this miracle is depicted on the northern gate of the stupa at Sanchi. Hiuen Tsang (Beal II 48) reports the *chankama* on the site of *Rishipatana*. Fahien also had seen a '*Ratana Chankama*' at Gaya (Waldschmidt and Mehendale 1963).

At Kanheri the inscription in cave No. 32 recorded the donation of a *chankama*. This is '*chankama*' in stone running from west to east.

The inscriptions at Kanheri are silent about the Bodhisatva. But there is a unique eleven-headed image of Avalokitesvara in the cave No. 41 (Gokhale 1991: 24).

Instead of one image of the Buddha, which is usually found in the tapering head-dress of Avalokitesvara; ten additional faces in three tiers piled over the head. The image has four hands. Avalokitesvara holds a lotus bud with a long stalk. A left hand holds a bottle and the right hand is in *Abhayamudra*.

The image of the eleven-headed Avalokitesvara is unique and shows the superb imagination of learned Buddhist philosophers and exquisite skill of the artists. He is shown as an attendant of Amitabha Buddha. Amitabha Buddha is the lord of the Blessed Land of Bliss in the west. Surprisingly, the sculptural representation of Amitabha Buddha and the eleven-headed Avalokitesvara is in the western corner of the cave. The Mahayana *Sutrasangraha* lists the ten powers of the Bodhisatva as follows:

1) *Adhimuktibalam* - Faith
2) *Patisammukhananabalam* - Power of computation
3) *Bhavabalam* - Power of self culture
4) *Patibhanabalam* - Illumination
5) *Patipattibalam* - Proper behaviour
6) *Samadhibalam* - Power of concentration
7) *Punyabalam* - Power of merit
8) *Ksantibalam* - Power of forbearance
9) *Jnanabalam* - Power of knowledge
10) *Prahanabalam* - Power of abandoning

The learned monks of Kanheri incorporated classic ideas of literature and directed the highly skilled artisans to create sculptures of Avalokitesvara. The ten heads of Avalokitesvara represent his ten powers, and he refuses to assume Buddhahood until all beings are rescued (Fig. 6-7).

Another remarkable architectural feature at Kanheri is its cemetery (Nirvanavithi). The burial gallery (Nirvanavithi) is a long terrace under the rock shelter in the southwestern corner of the Krsnagiri Hill. It is about 1 km from the main Chaitya and approachable by rock cut steps. The front portion of this shelter faces west and is completely washed away. The *Nirvanavithi*, whose floor is covered with bricks and brick-dust is about 180 m in length. Many stepped-harmikas made of stone are strewn around the brick foundations (Fig. 8).

At the entrance of this gallery, there is one small inscription which reads as Parigahita along with the Buddha's footprints. This suggests that it was favoured by the Blessed-one. At one-third of the distance from the

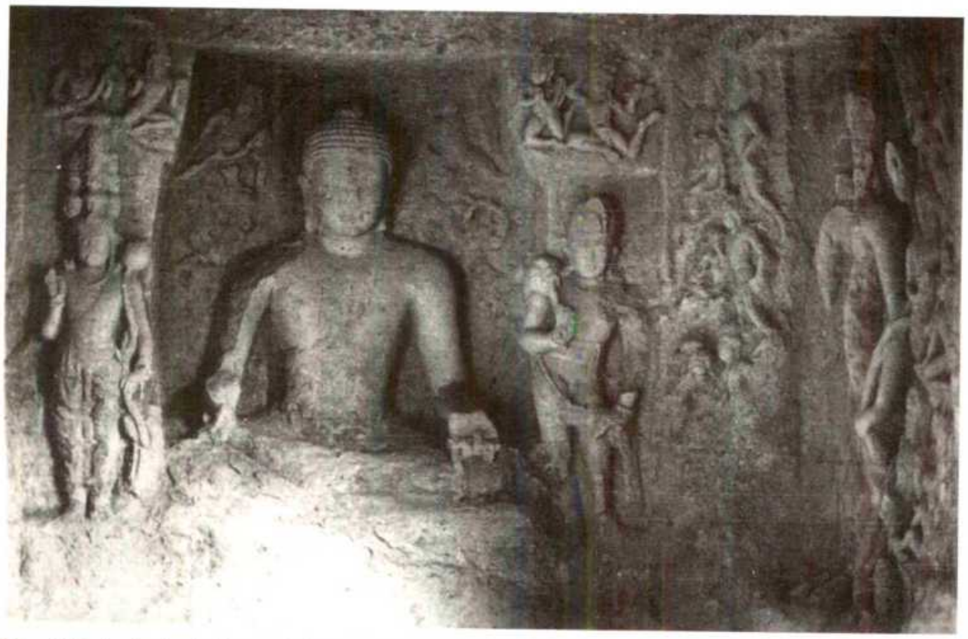

Fig. 6 Kanheri: Amitabha and eleven-headed Avalokitesavara

north end there is a sixteen-sided polygonal stupa decorated by sculptures. Behind this stupa there are three small chambers symbolically representing three triratnas namely Buddha, Dhamma and Sangha. The Buddha seated on the lion's throne recalls the passage in Simhanada Sutta which states that in the Sangha the Buddha used to speak in a lion's voice. Parisasu Simhanadam Nadati (Majhimanikaya 1.12) means that in the meeting, he roared like a lion.

In 1853 West (1862:112) excavated these stupas and prepared an excellent report. The archaeological remains of the brick stupas were not enough to provide any definite conclusion regarding their contribution to the general cultural complex at Kanheri. In 1975 when I visited Kanheri I observed a few well-cut stone-slabs lying upside down. When I explored this valley, I discovered twenty-six epitaphs. These epitaphs are inscriptions which have recorded the names of monks along with their scholastic merits and the stupas were erected in the name of these monks.

Unlike the stupas at Bhaja and Bedsa, Kanheri has a special funeral gallery (*Nirvanavithi*) having significant inscriptions. These rooms which represent Buddha, Dhamma and Sangha, have a polygonal decorated stupa in the centre with a canopy. All these features indicate a remarkable architectural skill, which is unparallel in India.

The epitaphs record the names of teachers of high religious achievements. They not only throw light on ancient Buddhist monastic institutions but also offer remarkable evidence for the first time of the tradition of teachers in western India. This tradition continued even in the Rashtrakuta period at Kanheri. The Shilahara king Pullasakti who was the feudatory of the Rashtrakuta king Amoghavarsha I made a donation to the Krsnagiri Maharaja Mahavihara for the purchase of books. The inscription is recorded on the entrance of the cave in which the benches for students have been excavated. Kanheri was a great educational centre.

A few epitaphs are discussed (Fig. 9):

Epitaph-1 L.1 Theranam bhadanta Dama
L.2 nam anagaminam Thubham

For the attainment of Arhathood a Bhiksu has to pass through four stages:

Sotapanna – a Bhiksu who is following the eight-fold path
Sakadagami – a Bhiksu who takes only one birth
Anagami – a Bhiksu who is free from rebirth as human being

Epitaph-2 L.1 Theranam Ayya Mahanam ara-
L.2 hantanam chhalabhiyanam pati
L.3 sambhidapattanam thubham

The sthavira Mahan was Sadbhinani and had attained patisambhidas

Sadbhinana indicates six normal states:

(1) Idhi – levitation
(2) Dibbastota – heavanly ear
(3) Parachittvijanana – telepathy
(4) Pubbanivasa – knowledge of three previous births
(5) Dibbachakkhu – divine vision
(6) Asavakhayanana – destruction of depravities

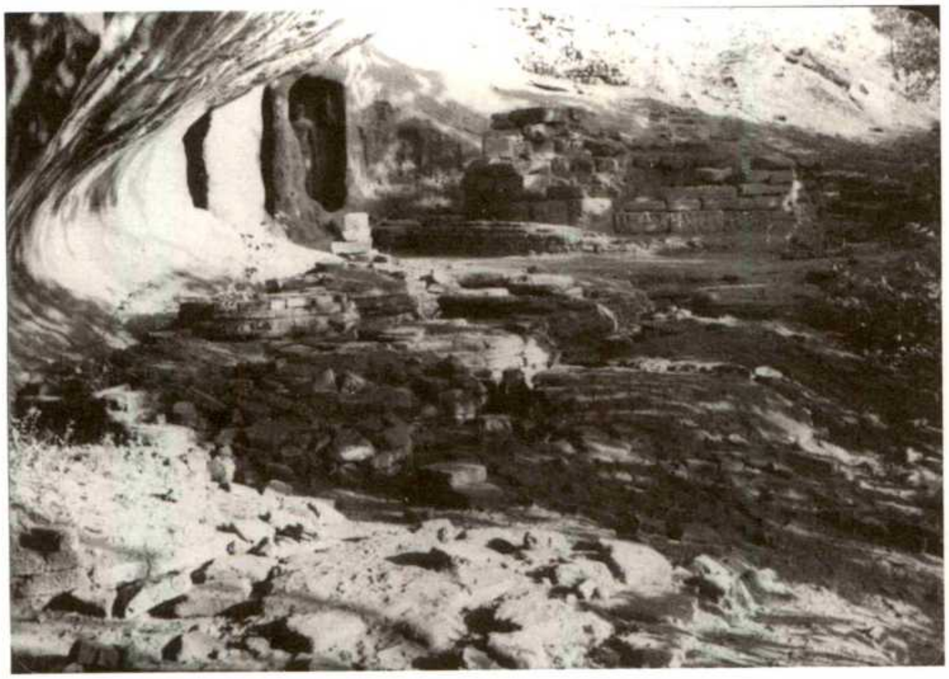

Fig. 7 Kanheri: Nirvana vithi

The monk had attained patisambhidas. There are four kinds of patisambhidas.

(1) Atthapatisambhida – analysis of text

(2) Dhammapatisambhida – reasoning of text

(3) Nirutipatisambhida – interpretation of religious text

(4) Patibhanapatisambhida – illumination.

These are four powers of penetrating into the hearts of people and could be achieved only by arhats.

Epitaph-3 L. Theranam bha (danta)
Arahantanam Jhayinam thubham

The monk was "Jhayi". This is a technical term for special religious experience. It may be (1) Vitarka, (2) Vichara, (3) Priti, (4) Sukha and (5) Ekagrata. The arhat at Kanheri had these special qualities.

Epitaph-4 L.1 Theranam Ayya Vijaya
L.2 Senana tevijanam
L.3 Arahantanam thubham

The stupa was erected in the honour of Sthavira Vijayasena. In the Buddhist tradition a monk who has attained three-fold knowledge is called "Tevijja". According to Dighanikaya, three types of knowledge are (Kasyapa 1958: 68-71):

(1) Pubbanivasa – knowledge of three previous births

(2) Dibbachakkhu – divine vision

(3) Asavakhayanana – destruction of depravities

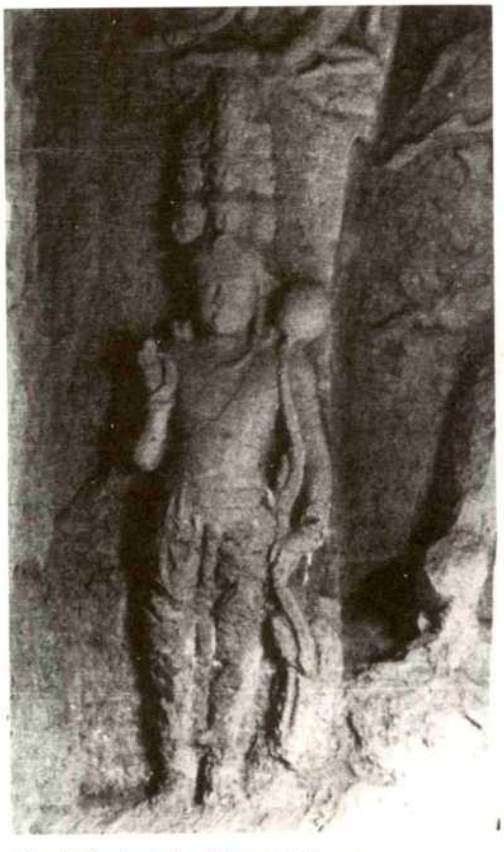

Fig. 8 Kanheri: Avalokitesavara

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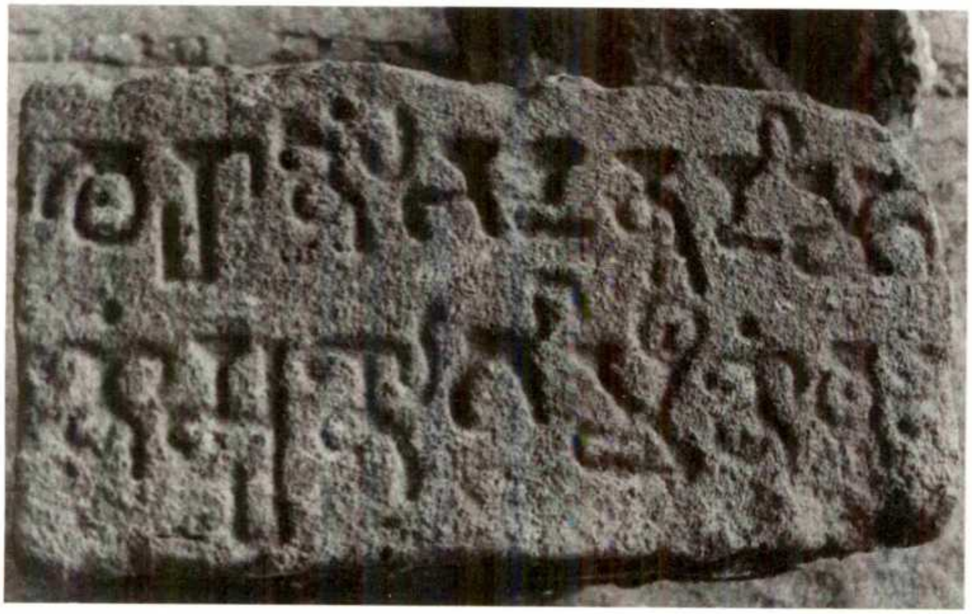

Fig. 9 Epitaph-I

To a Sarvjna all knowledge is transparent. In Theravada, knowledge is considered as the supreme quality of man. Knowledge as understood in Buddhism is different from the principle of Atman as Brahman in the Upanisads. The mysticism of the Upanisads is absent in Buddhism but appropriate training of body and mind for achieving truth and excellence as propounded by the Upanisads was accepted by Buddhism is once again proved by the inscriptions at Kanheri (Kasyapa 1960).

The architecture and inscriptions at Kanheri perfectly followed literary norms and reveal that Knaheri was modelled like the Jetvana monastery. The qualifications Tevija, Anagami, Jhayi and Sadbhinani of monks prove that it was a great educational centre of Abhidhammapitaka.

The practice of naming a monastery was well known in Buddhist literature. Jetvana monastery at Sravasti, and Ghositaram at Kausambi were often described in Buddhist literature. Krsnagiri Maharaja Mahavihara in western India was established on small scale in the Mauryan period and developed as a great educational centre in the ninth century A.D. The name Maharaja Mahavihara conveys the real meaning par excellence.

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A.V. Joshi and S.K. Biswas, *Man and Environment* XXXII(1): 23-32 [2007].
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Studies on Surface Features of Quartz Grains of Quaternary Successions of Lower Tapi River Basin, South Gujarat – their Environmental Implications

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Abstract

The South Gujarat terrain forms one of the important segments along the western margin of the Indian sub-continent from the point of view of its geomorphic and geologic diversities. The northern portion of this terrain is marked by the lower Tapi river basin (LTRB) comprising rock formations of varying ages. The sediments belonging to the widely distributed Quaternary successions within LTRB are quite interesting from the nature of their disposition and environment of deposition. The study of the surface features of quartz grains belonging to the Quaternary clastic sediments of LTRB have been carried out for the first time. The data obtained from this study supplemented with the field observations has helped to understand their transportation history and nature of processes that governed their deposition. The features which are commonly observed include conchoidal fractures, coalescing irregular impact pits, straight and arcuate steps, straight and curved scratches, mechanically formed 'V's, friction features, breakage blocks and cleavage planes.

Introduction

The South Gujarat terrain constitutes one of the important segments of the west coast of India and occupies a significant position along the passive western margin of the sub-continent. This segment forms a part of the Cambay and Narmada rift systems and is unique from the point of the view of geomorphic diversity and climatic vicissitudes. The Lower Tapi River Basin (LTRB), i.e. the study area demarcates the northern portion of the South Gujarat terrain and lies between latitudes 21° 05' N, and 21° 30' N, and longitudes 72° 37' E and 73° 30' E (Fig. 1). It attains an approximate rectangular shape with E-W length of about 98.92 km and N-S width of about 58.22 km, covering an overall area of 5759 km^2.

Physiographically the LTRB is bounded by the watersheds of Narmada and Purna rivers in the north and south respectively, the Arabian Sea delimits the western boundary, however in the east, the area abuts the trappean plateau of Deccan basalts. Presently, it is drained by the rivers Kim, Tapi and Mindhola and their tributary streams.

The LTRB comprises a thick sequence of exposed surficial outcrops of Quaternary (Middle Pleistocene to Recent) (Biswas 2005) sediments that rest unconformably on the Tertiaries and Deccan Trap basements. These deposits have received less attention from the earlier workers in terms of their nature and environment of deposition. In the present study an attempt has been made to study these sediments taking into account the surface

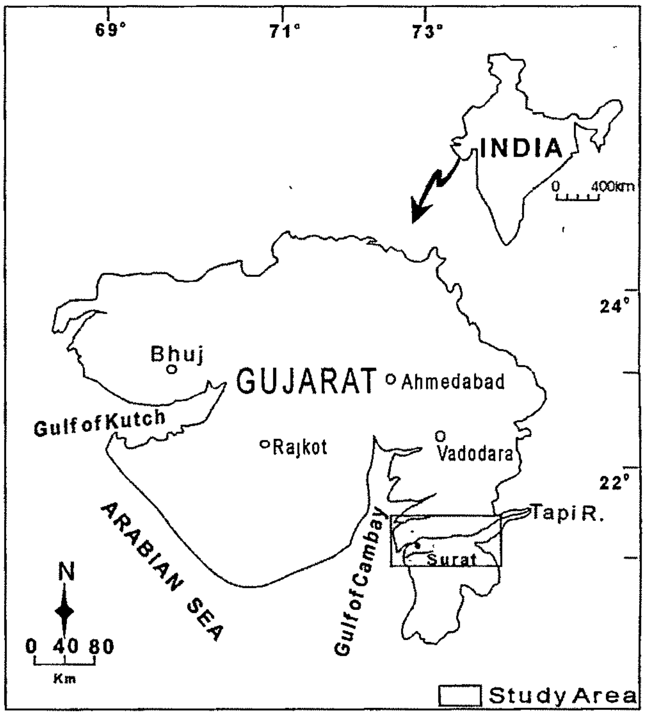

Fig. 1 Location map of the study area

Received : 10-10-2006
Revised : 12-2-2007
Accepted : 25-3-2007

features of the detrital (quartz) grains supplemented with the field observations in order to understand the transportation history and the nature of processes that governed their deposition during the Quaternary times. Such studies are very important in deciphering the environments of deposition of sediments particularly in the area under present investigation which occupy a significant position along the western margin of Indian sub-continent and comprises considerable accumulation of these Quaternary deposits.

Geological Set-Up

The study area (LTRB) forms an integral part of the three major tectonic elements bordering the western margin of India, such as the Cambay, Narmada and Tapi, comprising variety of geological formations ranging in age from Proterozoic to Recent (Fig. 1). Although majority of these geological formations are reported in the sub-surface data, however, the exposed outcrops belong to the Deccan Traps (Upper Cretaceous – Eocene) overlain by Tertiary and Quaternary deposits. Based on the earlier works (Rao 1969; Chandra and Chaudhary 1969; Gadekar 1977; Kaila *et al.* 1981; Agrawal 1984) and the author's field observations, the litho-stratigraphy succession of the study area has been formulated (Table 1).

Quaternary deposits, also known as "Gujarat Alluvium" (Chandra and Chaudhary 1969) show an extensive distribution in the alluvial and coastal plains of the study area. The Quaternary sediments rest unconformably on the erosional surfaces of Deccan Traps (Upper Cretaceous – Eocene) in the southern and eastern parts and partly on the Tertiary sediments (Kand Formation, Middle to Upper Eocene) in the northern portions. The sub-surface data on these sediments observed in the bore-hole records and the DSS profiles (Kaila *et al.* 1981) also supports the above observations.

The Quaternary sedimentary successions observed at various locations within the LTRB show well laminated lithological units representing cycles of fining upward sequences, comprising clastic accumulation of gravels, sands, silts and clays, wherein the later units dominate. The integrated litho-stratigraphic succession of LTRB show four cycles of sedimentation representing a fining upward sequence. The first cycle commences with a conglomerate unit directly resting over the Deccan Traps, followed by gravelly and cross-bedded sands, silts and a calcretised mud member. The conglomerate horizon comprises sub-angular to sub-rounded trappean clasts with varying sizes, whereas the sand member shows planar as well as trough cross-stratifications having azimuths in NE and SW directions with inclination angles varying from 15° to 20°. The fore set beds are found to show an average thickness of about 30 cm whereas the maximum length of the cross sets is recorded to be 65 cm. Compositionally the sand members comprise sub-angular to sub-rounded grains of quartz of varying sizes and basaltic fragments. The silty members, at places, show poor compaction and occasionally exhibit the presence of broken shell fragments within them. The second cycle commences with a cross-bedded gravelly sand member which shows pedogenic features such as burrows and tubes which are filled with calcareous materials. This unit also shows intense calcretisation and comprises sub-rounded to sub-angular basaltic fragments with varying sizes. The following sand unit is poorly sorted and contains calcified burrows. The silty sediments are well sorted and the clayey units are calcretised wherein the calcretes occur either as thin layers, irregular nodules or tubes of varying dimensions. The third cycle begins with a conglomerate member, followed by gravelly sands, silts and pedogenised mud member..The fourth cycle comprises laminated silts followed by a calcretised mud member. The nature and composition of the clasts indicate their proximal source and seem to have been derived from the erosion and denudation of the Trappean rocks and Tertiary sediments.

Calcretes are a form of duricrusts, defined as "a terrestrial material composed dominantly, but not exclusively of $CaCO_3$, which occur in states ranging from nodular and powdery to highly indurated and result mainly

Table 1: Litho-stratigraphic succession of the study area

Age	Formation	Lithology
Holocene (Sub-Recent to Recent)	-	Soil, Clays, Silts, Sands, Gravelly sands, Gravels (Newer Alluvium).
Middle to Late Pleistocene	-	Clays, Silts, Sands, Gravelly sands, Gravels, Siltstone, Conglomerate (Older alluvium).
Unconformity		
Upper to Middle Miocene	Kand	Calcareous sandstones. Shales, Marls and Limestones.
Unconformity		
Upper Cretaceous to Eocene	Deccan Traps	Basaltic rocks and its varieties.

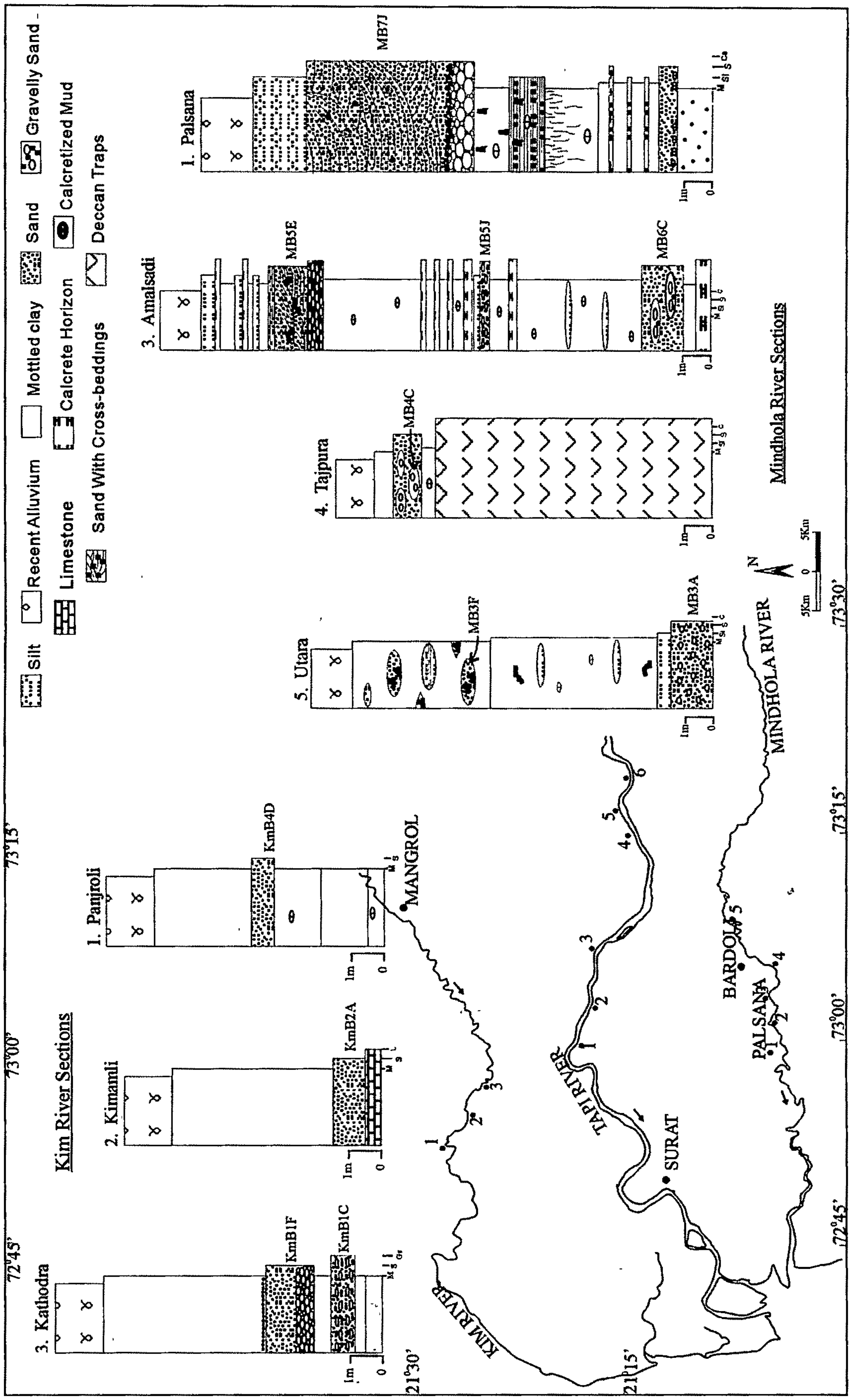

Fig. 2 Map showing exposed Quaternary successions along the Kim and Mindhola rivers

from the displacive and/or replacive introduction of vadose carbonates in to greater or lesser quantities of soil, rock or sediments within a soil profile" (Watts 1980). Although calcretes are observed almost everywhere in LTRB, however an illustrative sequence of calcretisation beginning from calcified soil to highly indurated forms is noticed only in the cliff section near Dhatwa village.

Methodology

In the present investigation, the surface micro-textures of the quartz grains representing the sand members have been examined using the standard techniques of Scanning Electron Microscopy (SEM). Earlier workers (Krinsley and Donahue 1968; Krinsley and Doornkamp 1973; Ly 1978; Manker and Ponder 1978; Higgs 1979; Culver *et al.* 1983: Manickam and Barbaroux 1987) have attempted this technique to study the surface features of quartz grains to understand their transportation history and depositional environments.

About 100 quartz grains representing the sand members of the Quaternary successions exposed along the Kim, Tapi and Mindhola river cliffs (Fig. 2-3) were identified and treated following the technique suggested by Krinsley and Doornkamp (1973) and Manker and Ponder (1978).

The representative samples were initially treated for wet sieving in order to remove the finer fragments (< 62 μm). Later, the coarser fragments (> 62 μm) were dry sieved and quartz grains having approximately same dimensions were picked up from each of the samples using binocular microscope. These grains were then treated with dilute hydrogen peroxide (H_2O_2) to remove organic and inorganic matters and subsequently with dilute hydrochloric acid (HCl) to remove coatings. The treated quartz grains were later coated with gold using POLARAN – SC 502 – Sputter Coater and scanned with a LEO (Leica Electron Optics) Electron Microscope 430 at various magnifications. The various surface textures observed on these grains have been computed in Table 2 and Fig. 4-6.

The features which are commonly observed include conchoidal fractures, coalescing irregular impact pits, straight and arcuate steps, straight and curved scratches, mechanically formed 'V's, friction features, breakage blocks and cleavage planes.

Results and Discussion

The study on the surface features of the quartz grains belonging to the Quaternary sediments of the LTRB supplemented with field data clearly reflected the nature of processes that governed their transportation and deposition.

The various surface features identified includes conchoidal fractures, coalescing irregular impact pits, straight and arcuate steps, straight and curved scratches, friction features and mechanically formed "V" marks, which are clearly suggesting the influence of fluvial processes and energy conditions (Higgs 1979; Manker and Ponder 1978 and Manickam and Barbaroux 1987). Manker and Ponder (1978) are of the opinion that the presence of irregular pits points to a high energy conditions of the sub-aqueous medium. Krinsley and Funell (1965) have suggested that the presence of impact features indicate grain to grain and grain to substrate collisions whereas presence of different type of scratches are attributed to the movement of sharp edges against the grains during their transportation in a high energy aqueous medium. According to Higgs (1979), the presence of conchoidal fractures as well as straight and arcuate steps on the grain surfaces indicates a short transportation and rapid deposition. He has further suggested that the "V" marks on the quartz grains are attributed to the impacts and represent their formation in sub-aqueous and aeolian environments under high-energy conditions. Since less than 50% of the observed quartz grains of the study area comprises the "V" marks, it clearly indicates their fluviatile nature (Morgolis and Kennett 1971).

The riverine nature of the sediments is also supported by the field evidences preserved within the Quaternary sedimentary record of LTRB. The primary sedimentary structures such as the planar and trough cross – stratifications, their angle of inclination and the length of their cross-sets within the sand units point to their formation on account of fluvial processes. The sub-angular to sub-rounded nature of the clasts, their composition and the degree of sorting indicates that they have been derived from near source. The integrated Quaternary sedimentary succession comprising four cycles of fining upward sequences indicate their deposition under the channel – point bar – flood plain conditions. The composition of sediments and their textural characteristics reflect their short transportation history and proximal provenance. The sequence of calcrete development in LTRB suggests their non-pedogenic origin, developed on account of the lateral seepage of through flowing streams as well as ground waters. However, at certain locations stray evidences of pedogenic origin have also been noticed towards the top of the stratigraphic successions (Biswas 2005).

Based on the field observations of the exposed surficial outcrops of Tertiary and Quaternary sediments Biswas (2005) has opined that the continental Quaternary history of LTRB initiates from middle Pleistocene onwards. According to him, the absence of early Pleistocene sediment record as surficial outcrops in an around the study area strongly suggests a rapid subsidence of Tapi basin during early Pleistocene times. Ramnathan and Pandey (1988), based on their studies on the Neogene-Quaternary boundary in western Indian shelf have envisaged a regressive phase during early Pleistocene period and have documented the presence of early Pleistocene

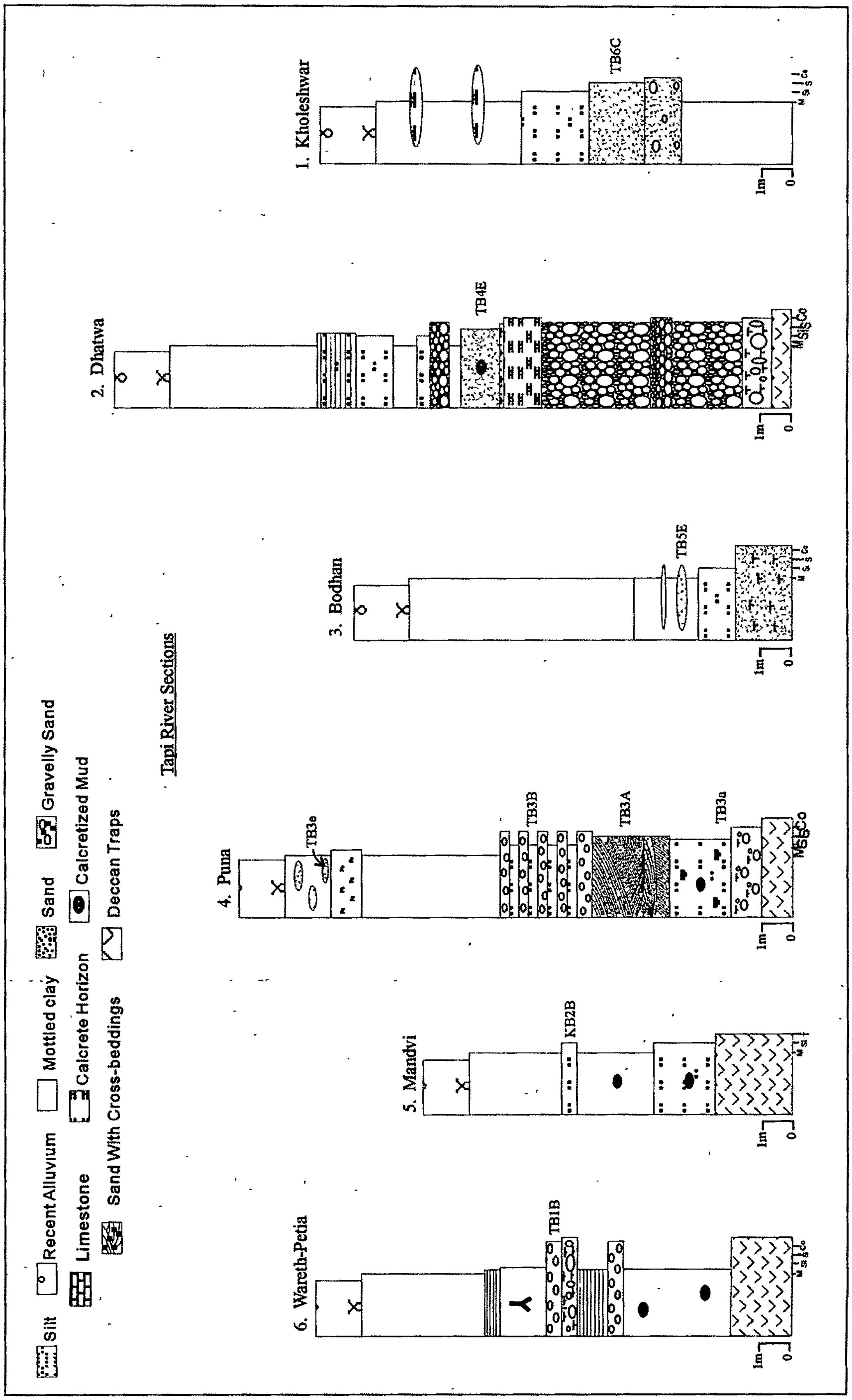

Fig. 3 Map showing exposed Quaternary successions along the Tapi River

Table 2: Various surface features exhibited by the quartz grains

Sample	Surface Textures																		
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
KmB1C	X	X	X	X	X	X	X	X	X		X	X		X	X	X			
KmB1F	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X
KmB2A	X	X	X	X	X	X	X	X	X	X				X	X	X	X		X
KmB4D	X	X	X	X		X	X	X	X				X		X				
MB3A	X	X	X	X		X	X	X	X				X		X				
MB6C	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X
MB5J	X	X	X	X	X	X	X	X	X			X		X	X	X			X
MB3F	X	X	X	X	X	X	X	X		X		X		X		X			X
MB4C	X	X	X	X	X	X	X	X		X				X		X		X	X
MB5E	X	X	X	X	X	X	X		X		X	X		X		X		X	X
MB7J	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X
TB3A	X	X	X	X	X		X		X	X		X		X	X			X	X
TB3a	X	X		X		X	X	X	X			X		X	X		X	X	X
TB4E	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X
TB2B	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X
TB3B	X	X	X	X	X	X	X			X	X	X		X	X	X			
TB6C	X	X	X	X	X	X	X	X	X	X		X		X		X		X	X
TB5E	X	X	X	X	X	X	X	X		X		X		X	X			X	X
TB1B	X	X	X	X	X	X	X	X	X			X			X			X	
TB3e	X	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X

(X – Present)

1-Sub-Angularity, 2-Medium Relief, 3-Irregular Pits, 4-Conchoidal Fractures, 5-Straight Steps, 6-Arcuate Steps, 7-Straight Scratches, 8-Arcuate Scratches, 9-Mechanical V's, 10- Angular Outlines, 11-Rounded Outlines, 12-Friction Features (Impact Pit), 13-Polishing, 14-Breakage Blocks, 15-Coalescing Impact Pits, 16-Non-Coalescing Impact Pits, 17-Meandering Ridges, 18-Oriented Fractures, 19-Cleavage Planes.}

sediments in the sub-surface stratigraphy of Hazira I well. Sali (1973), based on the archeological evidences have opined that the Quaternary deposits of central Tapi basin in Maharashtra range in age from middle Pleistocene to Holocene. Merh (1993) suggested the evidences of early Pleistocene deposits in other parts of Gujarat, however so far no surficial evidences of the co relatable sediments have been noticed in the present investigation. Since the beginning of the Quaternary period has been marked by active subsidence and sedimentation, the possibility of the presence of early Pleistocene deposits in the sub-surface geology of LTRB cannot be ruled, however, this aspect remains a matter of further investigation.

Taking into account the different surface textural features of the quartz grains and the overall field characteristics of the Quaternary successions of the LTRB it is very much evident that these sediments have been transported and deposited under the fluvial regime and represents fresh water accumulations.

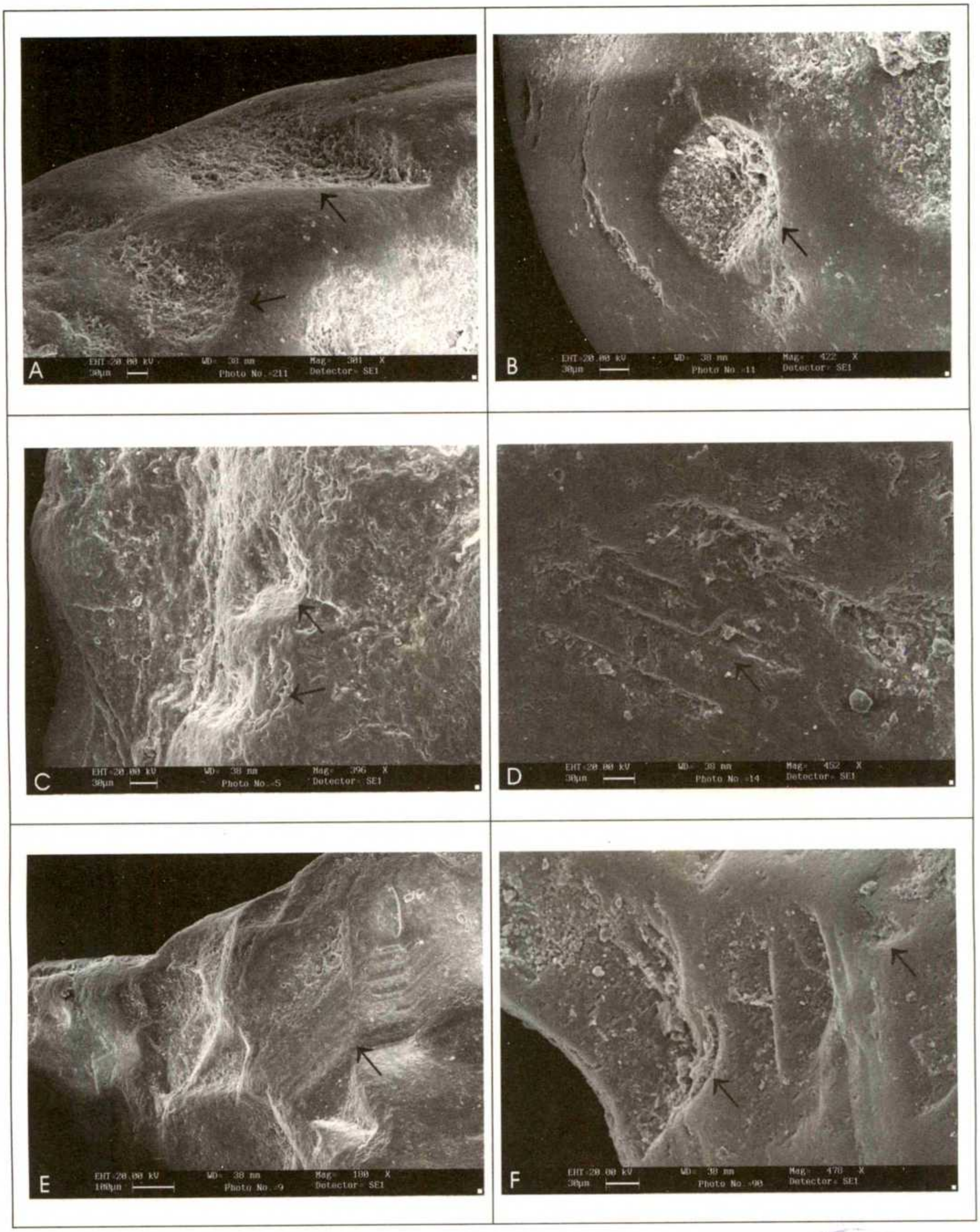

Fig. 4 SEM Photomicrographs showing the surface features of quartz grains (Location – Kim River Sections) [A, B – Impact Features, C – Straight and Curved Steps, D – Straight Scratches, E – Straight Steps and F – Conchoidal Fractures and Mechanically Formed "V"s]

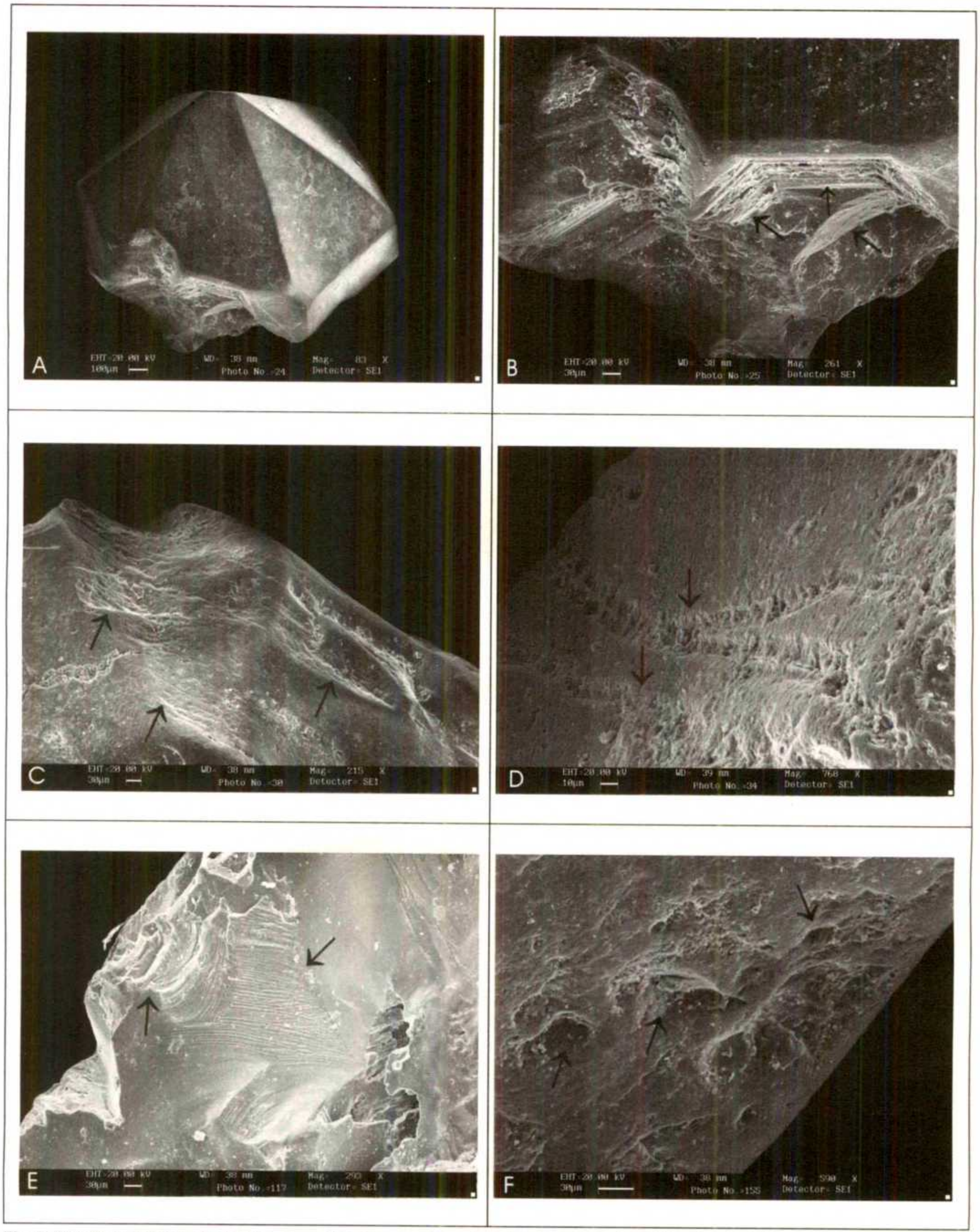

Fig. 5 SEM Photomicrographs showing the surface features of quartz grains (Location – Tapi River Sections) [A – Sub-Angular Nature, B,C – Straight and Curved Steps along with Oriented Fractures, D – Impact Features and Straight Scratches, E - Conchoidal Fractures and Straight Steps and F – Mechanically Formed "V"s]

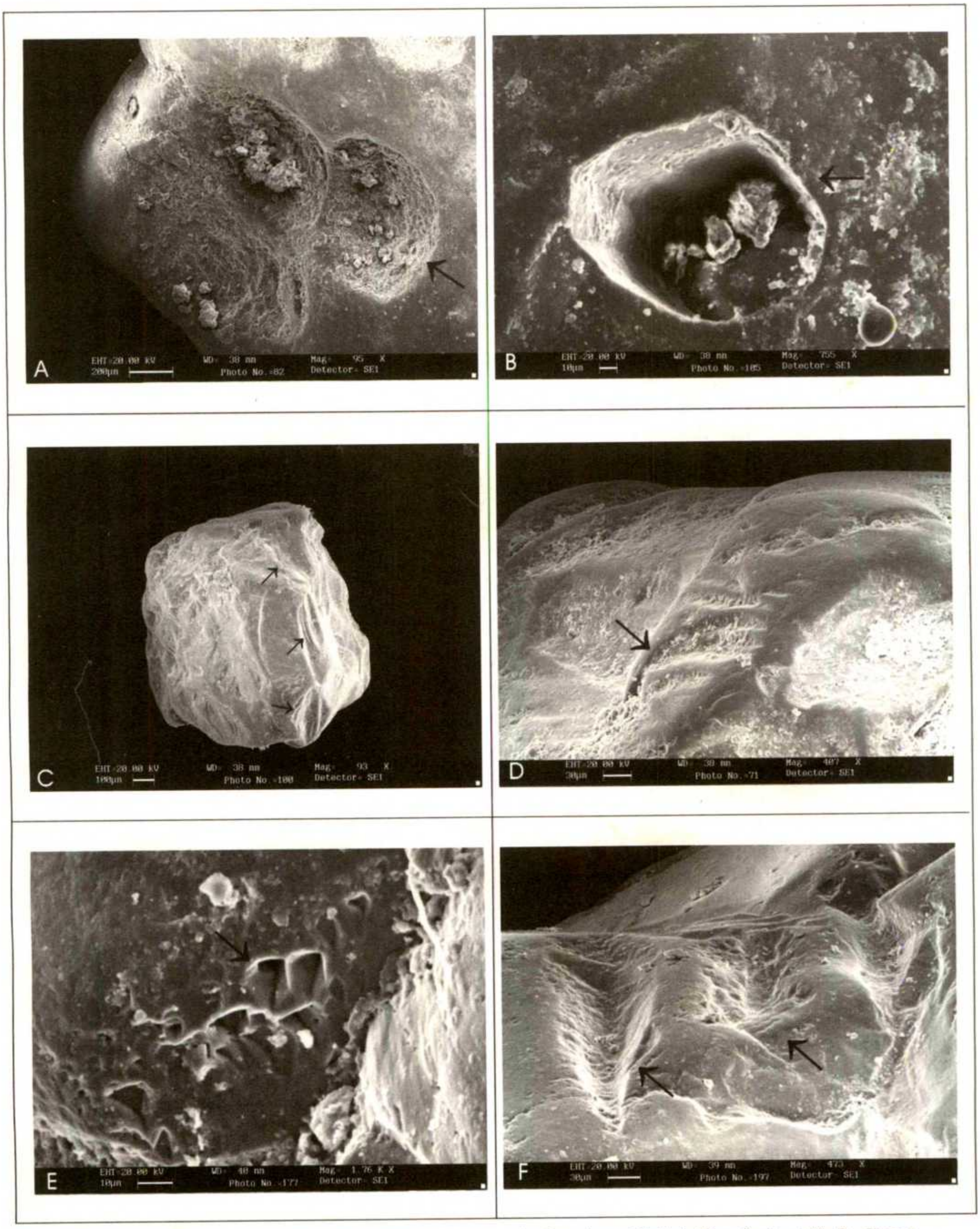

Fig. 6 SEM Photomicrographs showing the surface features of quartz grains (Location – Mindhola River Sections) [A, B – Impact Features, C – Straight and Curved Steps, D – Conchoidal Fractures, E – Mechanically Formed "V"s, and F – Scratches And Grooves on the surfaces of the grains]

Acknowledgements

The authors acknowledge with gratitude the financial assistance provided by the Department of Science and Technology, New Delhi (Project No. ESS/CA/A3-21/96). SKB is also grateful to Council for Scientific and Industrial Research {9/114(125)2K2/EMR – I}, New Delhi for the financial support through Senior Research Fellowship. The authors also extend their gratitude to the Head, Department of Geology, Mohanlal Sukhadia University, Udaipur for providing the laboratory facilities to carry out this work.

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Fluorine Dating of the Pleistocene Vertebrate Fossils from Manjara Valley, Maharashtra

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Abstract

The paper describes freshly obtained fluorine values on the vertebrate fossils found at two sites, i.e. Harwadi and Tadola in the upper reaches of Manjra Valley Maharashtra. The analysis was carried out using pH meter instead of the Ion selective electrode used by earlier scientists. Fluorine values were obtained on ten samples each having well-defined stratigraphic control at both the sites. The values compliment taphonomic observations and demonstrate that even if the bones are allochthonous, this method can be a useful for defining a chronological framework. In India this is the first attempt to combine taphonomy and chemical analysis for better understanding of chronological perspective of the depositional history of skeletal remains in the Pleistocene.

Introduction

The examination of fluorine content in bones was initially undertaken by Morichine over two centuries ago (Morichine1802). Towards the end of the 19th century Carnot (1893) in France, Middleton (1844) in England and Wilson (1895) in U.S.A. also tried this method for relative dating. Oakley (1948, 1963, 1980) revived it in England to study the Galley Hill skeleton and the Swanscombe skull. At Deccan College, it has been extensively employed and improvised as an effective means of relative dating. The collective efforts of V.D. Gogte, R.V. Joshi and A.A. Kshirsagar gave a new direction to the subject of relative dating in Indian Archaeology (Joshi and Kshirsagar 1986; Kshirsagar and Gogte 1990). The hypothesis is that there is a marked change in the fluorine contents in the bones of from the prehistoric to the historic period. The amount of fluorine in bones goes on increasing with its antiquity.

In the absence of Orion Ion Selective Electrode machine fluorine content can be directly estimated with the help of a very common and less costly instrument, a pH meter. This article describes this alternative method and the results of analysis of samples from Harwadi and Tadula from Manjara Valley, Maharashtra.

Principles and Research Methods

The element fluorine is widely distributed in the form of soluble fluorides in soils (Kshirsagar and Paddayya 1988-89) and therefore, occurs in trace quantity in ground water. Fluoride ions after coming in contact with buried bones are absorbed and locked in the crystals of hydroxyapatite by replacing hydroxide ions (Joshi and Kshirsagar 1986). The inorganic phosphatic material of bones thus gets converted to fluoroapatite, which is less soluble than hydroxyapatite. The close similarity of ionic radius of hydroxyl ion and fluoride ion as compared to that of the remaining halogen ions, i.e. Chlorine, Bromine, Iodine ions present in the ground water enables this continuous substitution to occur.

$$Ca_{10}(PO_4)_6(OH)_2 \rightarrow Ca_{10}(PO_4)_6F_2$$

The development of the fluoride ion sensitive membrane electrode makes it possible to measure fluoride activity directly in aqueous solution. The membrane of the fluoride electrode consists of Lanthanum fluoride crystal bonded into epoxy body. When this sensing element is in contact with a solution containing fluoride ion, an electrode potential is developed which depends on the level of free fluoride ion in solution (Front and Ross 1966). This method was first introduced in Deccan College in 1989 with the availability of Orion Ion Selective Instrument (Kshirsagar and Gogte 1990). The fluorine content could be directly obtained by this microprocessor-controlled equipment. The machine has, however, developed a technical snag and failed to work satisfactorily. We have, therefore, developed an alternative technique by using a digital pH meter. The technique is essentially the measurement of Emf for the fluoride solutions using a pH meter and comparing it with standard fluoride solutions.

Received : 13-9-2006
Revised : 28-5-2007
Accepted : 12-6-2007

The procedure is as follows:

a) A standard graph of Emf against concentration of fluorine is prepared. The ranges of measurement are between 1 to 100 ppm for fluorine and 0 to 400 millivolts for corresponding Emf.

b) Emf for the bone solution is recorded and using the above calibration graph, the concentration of fluorine in parts per million (ppm) is determined for the bones.

c) The phosphorus content in bone solution is also determined independently. Phosphate determination is essential since fluorine contents in bone are related to phosphate content and not to weight of bone, since fossilization is different in ancient bones. Finally the ratio of fluorine and phosphate is computed using the following formula:

Ratio = 100 F/P_2O_5

Materials Subject to Fluorine Analyses

The fossil material for the present analyses has been drawn from two localities in the Upper Manjra Valley. The fluorine/phosphate ratio from the earlier study (Kshirsagar 1993) was based on the materials from surface collections. The sites of Tadula and Harwadi (Fig. 1) are located at the banks of river Manjra in Districts of Latur and Beed in Maharashtra. River Manjra is a major southerly tributary of the river Godavari, arising in the northern edge of Balaghat Plateau near Gaurwadi in Ahmednagar district of Maharashtra. The number of fossil sites likes Dhanegaon, Tadola, Ganjur, and Wagdari have been previously studied. The palaeontology of this region is third in order of Pleistocene faunal diversity, only next to the Siwaliks in the northwest and Narmada Valley in Central India (Sathe 1989). These sites are far more richer than those in the lower stream of the Manjra in Karnataka and Andhra Pradesh, but the association of archaeological assemblages is best seen in the latter part of the Manjra Valley.

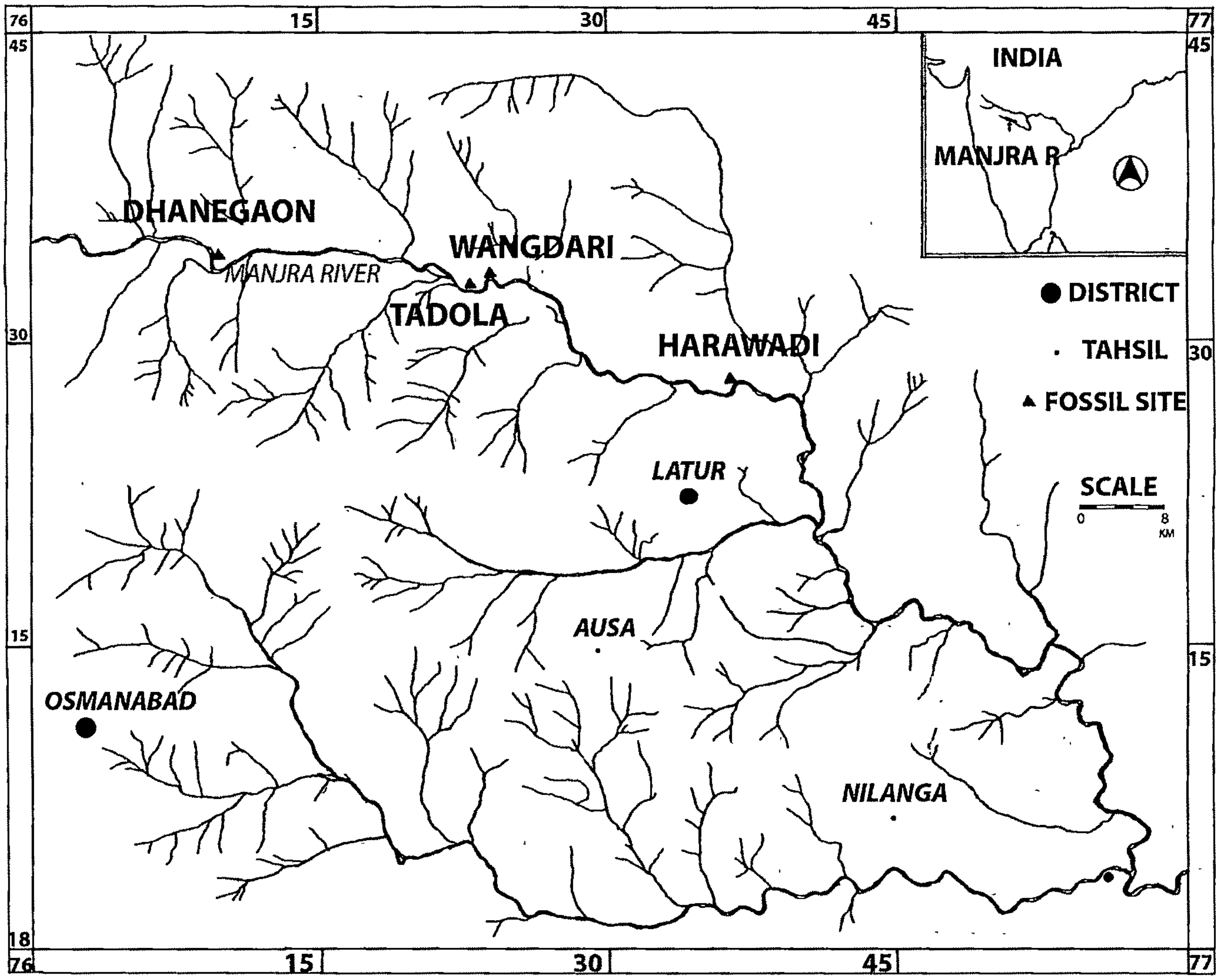

Fig. 1 Fossil-bearing sites in the Manjara Valley, Maharashtra

Table 1: Fluorine/Phosphate values of bones from Harwadi

Sample No.	Sample Name	%Fluorine	% P	% P_2O_5	Ratio
I	Rib fragment	1.410	11.37	26.04	5.41
II	Vertebral fragment of a Hippopotamus	0.213	1.62	3.72	5.72
III	Rib fragment of a large mammal	1.340	11.12	25.47	5.26
IV	Rib fragment of a large mammal	0.691	05.87	13.45	5.13
V	Rib fragment of a large mammal	1.290	11.06	25.33	5.09
VI	Tusk: Elephant	0.812	11.68	26.76	3.03
VII	Rib fragment of a large mammal	1.290	9.87	22.61	5.70
VIII	Rib fragment of a large mammal	0.910	12.00	27.46	3.31
IX	Tooth fragment; Bovid	0.204	13.12	30.00	0.68
X	Scapula: Elephant	0.870	11.87	27.19	3.19

Harwadi (18° 28' N; 76° 36' E)

The fossil site of Harwadi is situated on the left bank of the River Manjra. It was discovered in the year 2002 by the second author. Quaternary formations in the area have a lateral extension of about 1.5 km and are confined to broad and shallow gullies cut into lower pediplained surfaces developed over the Deccan Trap basalts. The total thickness of these formations is 8 to 9 m. Calcretised sandy-pebbly gravel is a rich fossil horizon and forms a bone bed spread for over a few hundred metres on the left bank of the river. Fossilised remains of tiger, hippopotamuses, rhinoceroses, elephants, large bovines, deer, turtle and hundreds of gastropods represent diverse palaeocommunities. Most of the collection is in pristine condition. The state of preservation and skeletal representation reveals an autochthonous situation rarely seen in a fluvial context. Field investigations have brought to light higher resolution of taphonomic coordinates at this newly discovered site, which has come to be known as an index site for broader taphonomic implications (Sathe 2005).
A few fossils were also found at this junction of clay and gravel, otherwise the fissured clay is without fossils. Silty sand and brownish clay overlies the fissured clay and which in turn is capped by the recent alluvium. The bones subject to fluorine dating come from the same level and share the same litho unit, i.e. calcretised sandy pebbly gravel. The average Fluorine/Phosphate ratio of 5.35 is in agreement with single unit occurrence of fossils (Table 1), confirming taphonomic explanation of the single burial event of the assemblage.

Tadola (18° 32' 50" N; 76° 23' 00" E)

Tadola is another important fossiliferous site to have yielded a good record of hippopotamus and elephant fossils (Sathe 1989). Quaternary deposits are found resting on the Deccan Trap and comprise sandy-pebbly gravel by yellow brownish sandy-silty clay or black-fissured clay. These deposits have a thickness of about 3 to 5 m, and indicate a low-energy depositional environment. Thick black-fissured clay overlying sandy-pebbly gravel defines the upper horizon, which is very rich in gastropods. Recent palaeobotanical investigations by M.D. Kajale and his team gave the evidence of fossil pollens and a large number of *in situ* gastropods, indicating the possibility of the region having large stagnant water pools for a considerable period of time (M.D. Kajale: personal communication). A large number of fossils have been discovered here in a stratified context and a few were found exposed on the bank of river following erosion by floods. Chemical analysis of these bones gives a ratio ranging between 2.24 to 6.19 (Table 2). The sequence of sample numbers is not in accordance with the depth at which they were documented, and hence the fluorine/phosphate ratio that may appear random need not be misinterpreted. Values suggest a longer temporal span stretching from the beginning of Late-Mid Pleistocene to almost the Terminal Pleistocene.

Discussion and Conclusions

Four years of extensive field investigations by second author in the Manjra Valley have brought to light the remains of a multi-species Pleistocene mammalian fauna in primary context especially at Harwadi. The *in situ* occurrence of fossilised skeletal remains of large herbivores is a unique with an amazing completeness of skeletal elements. These remains were found confined to barely a few hundred metres of lateral extension in consolidated sandy-pebbly gravel on the left bank of the Manjra river. The mode of occurrence is a testimony to minimal taphonomic modifications, thus qualifying as an autochthonous assemblage (Sathe 2005). The taxonomic fabric confirms

Table 2: Fluorine/Phosphate values of bones from Tadola

Sample No.	Sample Name	% Fluorine	% P	% P_2O_5	Ratio
I	Unidentified bone fragment.	0.398	4.50	10.30	3.86
II	Incisor: Hippopotamus	0.213	3.00	6.87	3.10
III	Long bone fragment	0.229	2.62	6.01	3.81
IV	Tusk: Elephant	1.860	13.12	30.05	6.19
V	Bone fragment	0.660	6.49	14.88	4.43
VI	Bone fragment	0.154	2.75	6.29	2.44
VII	Horn core fragment	0.275	3.12	7.50	3.84
VIII	Tibia	0.660	6.87	15.74	4.19
IX	Bovid rib	1.120	10.37	23.75	4.71
X	Bovid metatarsal	0.891	10.75	24.61	3.61

them to be of Late Pleistocene age which is further substantiated by the fluorine values. Whether the assemblage is an outcome of a single event of burial or a multiple burials and reburial episodes is a controversial issue (Sathe 2004). Can the time averaging of fossil ages (Behrensmeyer 1982) successfully address the problem of mixed assemblages? It has been observed that bones deriving from a particular context after remaining for a same length of time will have broadly comparable fluorine contents. Anomalous higher or lower fluorine values within the assemblages will suggest contamination of the assemblages by older or younger bones. (Demetsopoulos *et al.* 1983)

Fluorine/Phosphate ratio in the bones from Tadola and Harwadi varies between 3.0 and 6.19, indicating that the fossilised bones belong to the Late Pleistocene encompassing Upper Palaeolithic to Middle Palaeolithic periods. Fossil bones from Ghod Valley (Maharashtra), Son Valley (M.P.), and Kurnool Caves (Andhra Pradesh) have shown similar results (Table 3, Kshirsagar 1993). Approximate dates of these samples range from 47,000 to 9,500 B.P. For the Manjra Valley, it may be borne in mind that due to the absence of any Palaeolithic artefacts, cultural association in the regional framework of Western Maharashtra is taken as a time bracket for the Upper and Middle Palaeolithic. As all the fossils from Manjra, Godavari and Ghod valleys give comparable Fluorine/Phosphate ratios falling within the Late Pleistocene period, fossils obtained from this area which gives value in this range can be assigned to a similar time frame. Fossils from Kalegaon (19° 43' N; 75° 00' E) in Godavari Valley give the values from 3 to 6, which are very close to those obtained at Tadola as well as at Harwadi.

As regards Harwadi, the Fluorine/Phosphate ratios are well within 5 to 6 which probably represent an assemblage derived from a single depositional event. This is further substantiated by the taphonomic coordinates of the assemblage. These are on excavated material where the uniformity of skeletal material as well as the successive levels of sediments reflects congruity with the values obtained. Interestingly, the profile of Fluorine/Phosphate values at Tadola tell us a different story. Specimens 1 to 6 come from a stratified context where the ascending values do not necessarily match with depth at which they were collected. For example, samples (No. 1 and 3) from the lowermost fossil-yielding level gives the values 3.86 and 3.81, which are half of the ones 6.19 on sample No. 4 obtained on bones from upper levels. The Lack of uniformity between the values and depth suggests post-burial disturbances resulting in the mixing of fauna that perhaps coincided with the beginning of the process of fossilisation. The fluvial origin and taphonomic assessment of the fauna makes this a plausible hypothesis. This contrasts with Harwadi where the values do support geomorphological and taphonomic interpretations. A single higher value of 6.19 at Tadola is an exception against the cluster of much lower values within the range of 3 to 4. This higher value (6.19) possibly falls in a higher range from Nevasa, Bori and Hunsgi. A comparison between the Fluorine/Phosphate ratio and radiometric dates of vertebrate fossils from the Hunsgi-Baichabal valleys (e.g.1.74 myr uranium series dating/6.7 F/P_2O_5) and Kukdi Valley (0.67 ± 0.03 myr radiometric dating/ »5.84 F/P_2O_5) strengthens the authenticity of antiquity defined by these fluorine values obtained. Interestingly this is further supported by values of (e.g. 6.19) recently collected bones

Table 3: Table describing Fluorine/Phosphate ratio in fossilised bones from sites of different periods/ Cultures and various regions giving their approximate ages (Modified after Kshirsagar 1993)

Site/Region	Period/Culture	Approximate Age	100 F/P_2O_5
Sites from J & K, Andhra,Karnataka, Maharashtra, M.P, Langhnaj, Dhansura	Late Holocene Chalcolithic/ Neolithic	500-2000 B.C.	<1
Moti Pipli, Datrana (Gujarat), Jamba, Phalodi (Rajasthan)	Mid Holocene/ Term. Pleistocene	2500-6000 B.C.	1-2
Mudnur(Karnataka), KurnoolCaves (A.P.)	Early Holocene/ Upper Palaeolithic	7000-10,000 B.P.	2.10-3.70
Kalpi (Yamuna cliff)	Upper Palaeolithic	10,000-20,000 B.P.	3-5
Manjara Valley	Upper Pleistocene Upper Palaeolithic /		3.12-5.12
Ghod Valley			4.00-5.45
Son Valley			4.00-5.15
Belghat, Ratikarar in-Narmada Valley		20,000-40,000 B.P.	4.52-5.33
Kalegaon, Nevasa and Wangdari (Inamgaon)	Upper Pleistocene/ Middle Palaeolithic		4.24-6.00
Kalpi (Redepositted)	Late Mid. Pleist.		6.00-8.6
Hathnora, Gowarighat Narmada Valley (Lower Group)	Late Mid.Pleist./Mid. and Low. Palaeol	40ka – 2.20 myr	7.70-8.15
Hunsgi Valley Chirki,	Mid.Pleist./Acheul	1.74 myr	6.73-8.39
Nevasa Bori,	Mid.Pleist./Acheul	0.67 myr	8.11-8.29
Siwalik fossils	Lower Plei.?/Acheul Lower Pleistocene		7.01-8.05 6.66-8.45
Tertiary fossils (Kachchh)		>2 myr	8.15-9.42
Theoretical	Saturation	Value	8.92

from Morgaon (Sathe, *in press*) and call for a broader chronological framework for these assemblages. It may be summarised that fluorine dating eventually corroborates taphonomic interpretations at Harwadi and Tadola. On one hand, the average value of 5.35 at Harwadi, compliments observations regarding a single event of burial, while the range of Fluorine/Phosphate ratio at Tadola clearly suggests a mixing of faunal assemblages (multiple burial events) that can be termed as allochthonous.

Inter-site and intra-site analyses of fluorine values with respect to skeletal elements, animal species and geochemical profiling is under study. It is expected that this method of relative dating will be placed on a stronger footing as a viable method, especially in the light of the paucity of any other datable material at a site.

Acknowledgements

The authors are grateful to Professor V.D. Gogte, Joint Director, Deccan College for going through the paper critically and giving valuable suggestions. Suggestions on the paper by Professor S.N. Rajaguru have gone a long way in making this presentation a useful endeavour. Fluorine values on the fossils from Tadula (for specimen 1 to 6) are based on specimens discovered by Professor M.D. Kajale and the authors are thankful to him for making them available for study. Thanks are also due to Mr. B.S. Waghmode for preparing the locality map of the Manjra Valley.

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Thathappatti: Tamil-Brahmi Inscribed Hero Stone

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Abstract

Tamil-Brahmi inscribed hero stone is found engraved on a menhir installed as part of an urn burial. This inscribed menhir, the first of its kind, in India throw a welcome light on the understanding of early historic period. The transformation of sepulchral monuments from Iron Age to Early historic could be understood in the backdrop of this hero stone. The literary evidence on hero stones found in Sangam literature is well attested by the material evidence found on the ground. Next to Pulimankomabai, this is one of the earliest hero stones so far found in India.

Introduction

One of the earliest satisfactorily deciphered scripts in India is Brahmi script. All other earlier scripts like Indus script and graffiti marks are yet to be deciphered though there are some claims on the nature of the script. The term 'Brahmi' is found in the list of scripts practising in India during the preparation of religious texts like Buddha Jataka *Lilithavistara* and Jain scripture *Pannavanasutta* and it finds its place as the foremost script. There are nearly 64 practising scripts in India during their claim but none of the religious sects claims the ownership of other scripts. It implies, therefore, that by this time this script became one of the prominent scripts of India. It is also clear from the list that there is a script in south India called in various terms like *Damili, Dravidi* and *Dramili.* Though we have not come across all the scripts listed in the literature but we do get three important scripts namely Kharoshti, Brahmi and Damili (Tamil). Now it is realized that Brahmi script is a variant of *Damili* or *vice versa*. The Brahmi script was

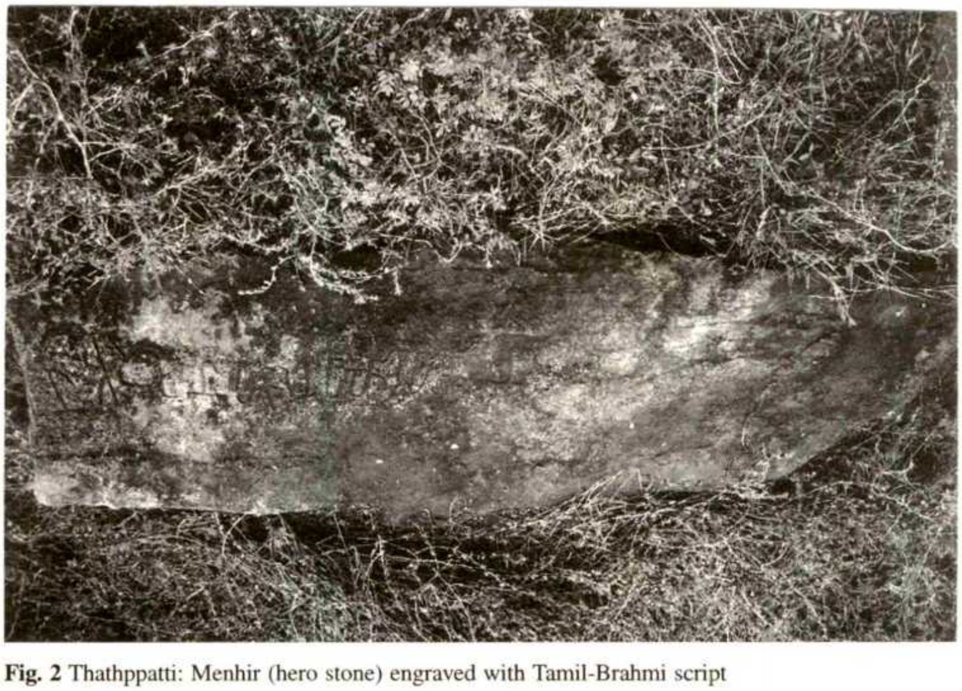

Fig. 2 Thathppatti: Menhir (hero stone) engraved with Tamil-Brahmi script

Received : 29-10-2006
Revised : 11-4-2007
Accepted : 25-4-2007

used the whole of India except in the present states of Tamil Nadu and Kerala, the so-called ancient Tamilakam. The language used in Tamil Nadu is Tamil so it is called Tamil-Brahmi and the language used in other parts of India is Prakrit. Instead of calling them as Prakrit-Brahmi, these are known as Asokan-Brahmi, Mauryan Brahmi, Northern Brahmi and so on based on king, dynasty and territorial affiliation. The Brahmi script found in Asokan-Brahmi and Tamil-Brahmi are not alike in all its form. There are peculiar scripts in Tamil-Brahmi and the same way all the Asokan-Brahmi scripts are not found in Tamil-Brahmi.

Palaeographically and linguistically Tamil-Brahmi differs from Asokan-Brahmi to certain extent. The scholars are entangled with various theories in identifying the origin of these two scripts, namely Asokan-Brahmi and Tamil-Brahmi. The crux of the problem is that both have been used simultaneously in India and in Sri Lanka. Different scholars have put forth quite a number of arguments both for and against the origin. The archaeological stratigraphy, epigraphic evidence and numismatic findings revealed in recent years differ to certain extent. The recent evidence of hero stones engraved with Tamil-Brahmi without admixture of any Prakrit loan words unearthed at Pulimankomabi and Thathappatti, and in archaeological excavations particularly at Kodumanal in Tamil Nadu and at Anuradhapura in Sri Lanka throw much light on this aspect, as well as generated much debate on the origin and spread of this script. In this paper, an attempt is made to place the recently discovered Thathappatti hero stone engraved (on a menhir) with Tamil-Brahmi scripts in front of scholars to judge their value and nature as it had broader ramification or implication on the history of India.

A hero stone on a menhir inscribed with a Tamil-Brahmi script, dating back to more than 2,200 BP was discovered in 2006 at Thathappatti and Nilakottai taluk, Dindugal district, Tamil Nadu. This remarkable discovery was made by the second author during a survey conduceted as a part of the project "Historical Atlas of South India". The hero stone is engraved with Tamil-Brahmi script on a menhir which was installed as a part of an urn burial. It was found on the southern bank of river Vaigai about 16 km south of Vattalakundu. The Tamil University team has discovered thousands of Iron Age burials in Tamil Nadu. In our recent exploration in the Vaigai river valley, hundreds of such sites have been discovered. The present site Thathappatti is one among them and is located on the southern bank of the river Vaigai probably on an ancient route connecting the Pandya and Chera country through Kambam pass.

This is the first discovery of its kind. This remarkable find throws up new challenges for scholars. Further, a potsherd of Russet coated ware reading *visaki* in Tamil-Brahmi was discovered at Kodumanal at an Iron Age (Megalith III) transepted cist (Rajan 1994: 74-76). This grave was also associated with a menhir (Fig.1 see cover 2). This evidence proved beyond any doubt that the Early Historic people also followed the custom of erecting sepulchral monuments such as cists. The present discovery further corroborates the Kodumanal findings. Therefore, this evidence stands as a unique example which helps in understanding the Early Historic milieu.

The first part of the menhir (hero stone) is broken, with the remaining part measuring 180 cm in height and 60 cm in breadth (Fig. 2). The original height of this stone

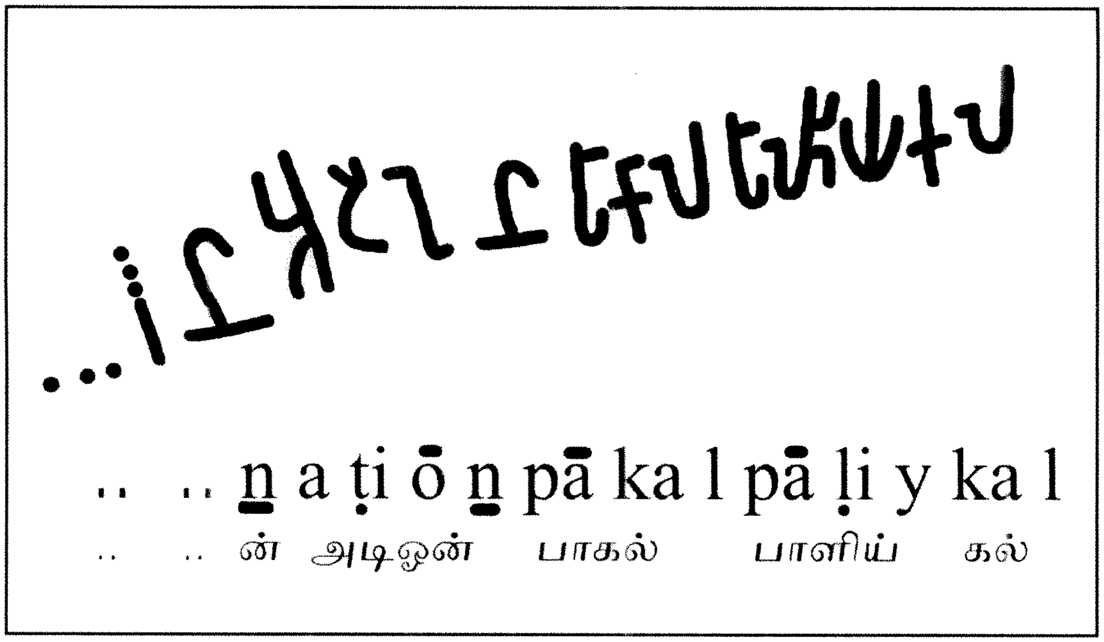
.. .. ṉ a ṭi ō ṉ pā ka l pā ḷi y ka l
.. .. ன் அடிஓன் பாகல் பாளிய் கல்

Fig. 3 Thathappatti: Readings of the inscription

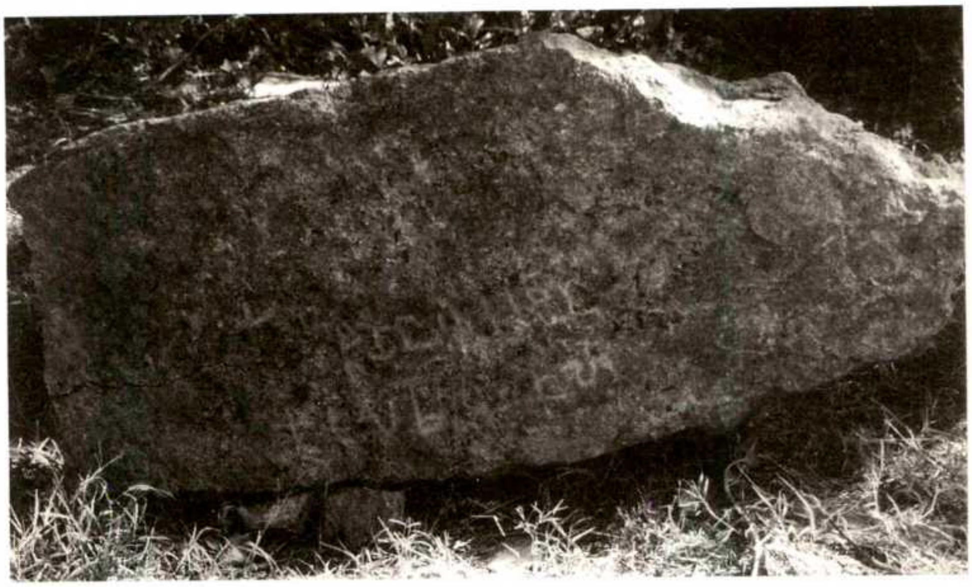

Fig. 5 Pulimankomabi: Hero stone (No. 2) engraved with Tamil-Brahmi script

would have been more than 200 cm. This hero stone was installed as a part of an urn burial, many of which are found at this site. They have been removed from their original position while levelling the fields for cultivation.

The hero stone has 13 letters engraved in a single line reading (Fig. 3):

. . .n ati oon paakal paali kal

It means that this hero stone (menhir > *kal*) is raised on a burial (*paali*) to a man called *paakal*, a servant of some chief/leader/master whose name is missing.

A characteristic feature of the early Tamil language tradition is the practice of writing grammatical suffixes beginning with vowels without joining the main word. This language tradition is followed in this inscription also. As regards orthography, short and long medials are not clearly distinguished and similarly there is no difference between vocalic consonants and pure consonants. The proper name suffix of *on* in *atioon* is written separately without *sandhi*. On palaeographic, linguistic and orthographic styles, this hero stone is considered to be early and of the 3rd Century B.C., and thus very important for the study of the Early Historic period of Tamil Nadu. The most interesting feature of this hero stone (menhir) is that it is found as part of an urn burial.

Three remarkable hero stones dated to around 2300 B.P. and inscribed with Tamil-Brahmi script have been discovered recently in March 2006 at Pulimankombai in Andipatti taluk of Teni district, Tamil Nadu (Rajan 2006: 1-5) (Figs. 4-6). The present site Thathappatti lies about 5 km east of Pulimankombai (Fig. 7). The large occurrence of Tamil-Brahmi inscriptions found in caves dedicated to Jains and Tamil-Brahmi found engraved on hero stones collected from the mid-Vaigai basin suggests that the region connecting the Pandya and Chera countries needs to be closely studied in order to understand the evolution and spread of Tamil language and script. Any future archaeological excavation with stratigraphical control would throw light on the origin of this script. This would also provide a clue to date the Sangam literature, which speaks extensively on various components of hero stones (Rajan 2000: 5-42).

Sangam Literature and Hero Stones

The *Sangam* literature indicates clearly that Iron Age monuments, particularly in the terminal phase of the Iron Age culture, were raised in memory of the heroes who died in cattle raids, and for whom *nadukal*s or menhirs were errected. These menhirs were later got transformed into hero stones (*virakal*s). The basic theme connected with hero stones in Tamil Nadu is that of cattle lifting. The earliest references to memorial stone is found in Sangam literature, where more than 25 poets describe it. These graphic descriptions suggest a structural transformation, as the tradition is continued over centuries.

The Sangam works, *Tolkappiyam, Akananuru, Purananuru, Malaipadukadam, Aingurunuru, Pattinapalai,* etc. describe memorial stones in detail. This graphic description gives an idea on the evolutionary process involved in the erection of memorials, starting from the Iron Age onwards. A close study reveals that the practice of errecting megaliths underwent a dramatic change through the years and finally culminated in *virakals* (hero stones). Broadly speaking, the transformation can tentatively be arranged into five distinct stages.

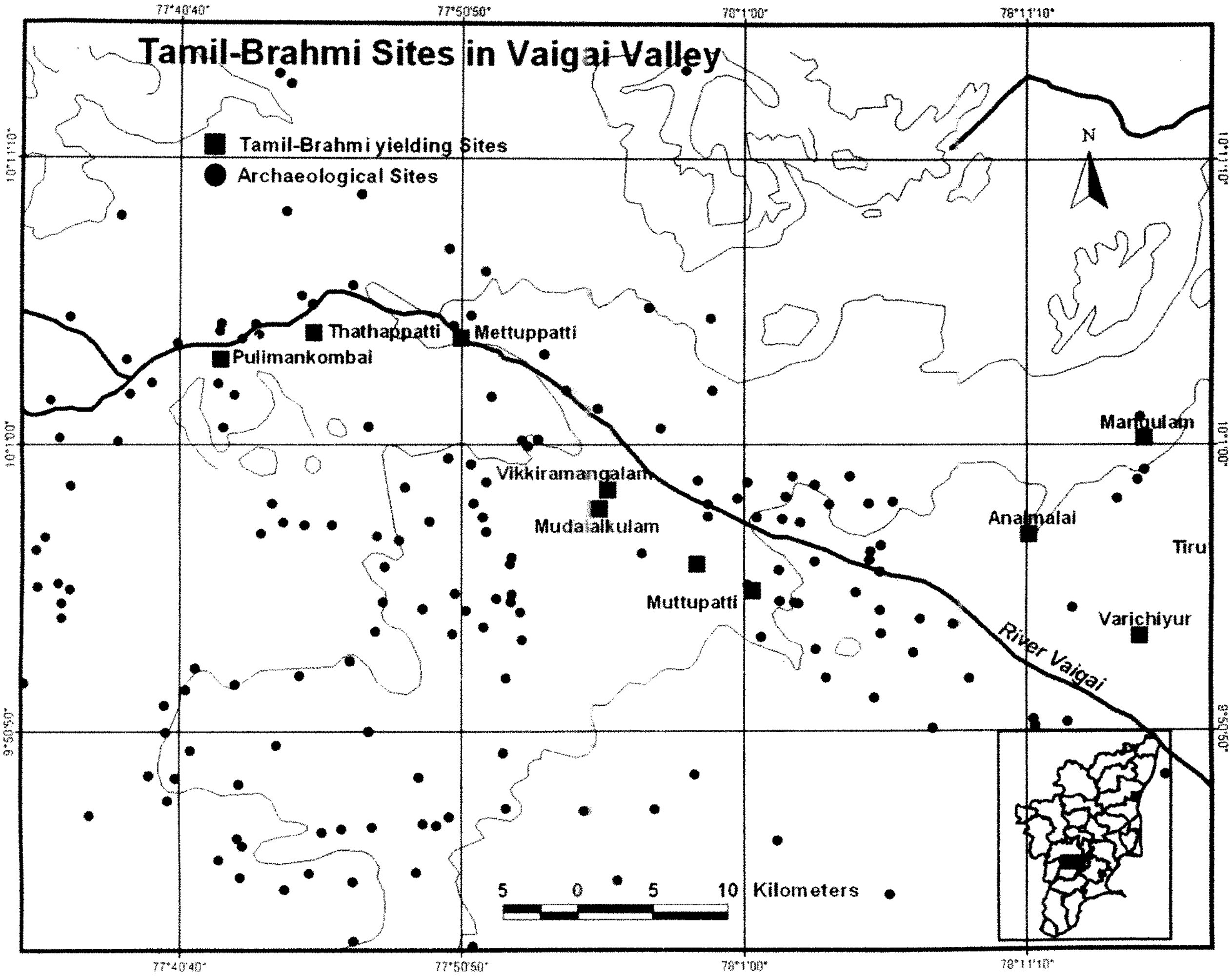

Fig. 7 Map showing the location of Thathappatti and Pulimankombai

In the first stage Iron Age graves (*patukkai*) were raised as a memorial for people who were shot at with arrows by *maravas* or *kanavas*. Terms as *ambin visai ida vilndor ennu varambu ariya uval idu patukkai* (cairn circle entombing a burial raised for the man who died by charging an arrow) (*Akananuru* 109:7-8), *vil ida vilndor patukkai* (cairn circle entombing a burial raised for the man who died by charging an arrow) (*Akananuru* 157:5), *al azhittu uyartta anchuvar patukkai* (cairn circle entombing a burial raised for the dead) (*Akananuru* 215:10), *patukalattu uyartta mayirt talai patukkai* (cairn circle entombing a burial raised in the burial ground) (*Akananuru* 231:6), *ambu ida veelndor vamba patukkai* (cairn circle entombing a burial raised for the man who died by charging an arrow) (*Purananuru* 3:21). These are clearly indicative of Iron Age burials (*patukkai*/cist). The term *patukkai* could be assigned to any grave type including cists. In these descriptions, the erection of a grave is clearly mentioned, but there is hardly any evidence to menhirs.

In the second stage, Iron Age graves were raised and menhirs (*nadukal*) was planted for the people who died generally in the cattle raid. Phrases include *naanudai maravar peyarum peedum ezhuthi atharthorum peeli suttiya pirangu nilai nadukal ... nirai kandanna uval idu padukkai* (cairn circle entombing a burial with a menhir,engraved with name and fame of a hero who retrieved cattle) (*Akananuru* 67:9-15) and *paraludai marungin patukkai serthi .... peyar porittu ini nattanare kallum kanrodu karavai tandu pakaivar ottiya neduntakai* (cairn circle entombing a burial with a menhir engraved with the name of a hero who retrieved cattle) (*Purananuru* 264). Till date, several menhirs associated with burials have been discovered in Tamil Nadu, but none yielded any script. The present evidence observed on a menhir at Thathappati is critical for understanding the evolutionary process of a burial system.

In the third stage, it appears that grave is abandoned and only the *nadukal* (menhir) or memorial stone was raised in memory of heroes who died in cattle raids. The term *natta polum nataa nedunkal* (*Akananuru* 269:6-7) refers to a menhir with script, probably devoid of any sculptural representation. The hero stones (menhirs) of Thathappatti and Pulimankombai also contain only scripts and are devoid of any sculptural representation.

In the fourth stage, the size of the menhir was reduced to the level of later-day hero stones. Graphic descriptions like *ezhuttudai nadukal* (menhir/hero stone having script) (*Akananuru* 53:10-11; *Ainkurunuru* 352:1-2), *pem mudir nadukal peyar peyam padarat thondru kuyil ezhuttu* (old hero stone engraved with name of the hero) (*Akananuru* 297:7-8), *kur uli kuyindra kodumai ezhuttu* (memorial stone having script engraved with a sharp chisel) (*Akananuru* 343: 5-7), etc., speak about the nature and content of the hero stones.

It is quite clear that Iron Age burials which are essentially and purely sepulchral in character were slowly transformed into *nadukals* or memorial stones which are commemorative in character. In all these five stages, it is largely associated with the *marava* or *kanava* community. In early stages, they were actively involved in killing people who passed through their territories. In later stages, it appears that they were assimilated as warrior servants (*sevakar/atioon*) by local chiefs/leaders/village heads in order to protect their cattle. There are references to these *maravas* fighting each other in a cattle raid (*Akananuru* 35). These people also served as bodyguards to kings (*Padirruppattu* 21, 55).

This study clearly suggests that the description found in literature, and the Tamil-Brahmi inscribed hero stones found at Thathappatti and Pulimankombai are critical evidence towards understanding cultural transformation that had taken place in the erection of memorial stones.

Rites and Rituals

Tolkappiyam, the earliest Tamil grammar, speaks of the rites performed during the erection of a memorial as follows:

> katchi kal kol nirpadai nadukal
> *sir-t-taku sirappin perumpadai valttal*
> (*Tolkappiyam, Porul*.2-5)

The rites *katchi, kalkol, nirpadai, nadukal, perumpadai* and *valttal* follow in a sequence. It is to be observed here, that the *Tolkappiyam* does not mention sculptural representations or inscriptions. Later commentators, who lacked a correct knowledge of the original tradition, interpreted this passage as the quest for a suitable stone, the marking of the figure of the dead person on it, and its ceremonial bath. However, in the context of archaeological data, we believe that *katchi* probably meant 'lying in state' for a while, (as is even now practiced) so that the relatives and friends can assemble and do perform ceremonial honours and wailing. *Kalkol*, likewise, probably meant the exposure of the body to elements, as would be the case in excarnation. Post-excarnation or partial burial is clearly indicated by evidence from excavtion at many Iron Age monuments. *Kal*, according to the contemporary *Paripadal* (3.88) meant the five elements; the compound *kalkol* in that case meaning, "allowing the elements to take possession" and do their work or in other words, to become one with the elements – *iyarkai eydutal*. *Nirpadai* would then refer to the ceremonial washing or purification of the few picked bones left after exposure at a much later date for its ceremonial burial, and *nadukal*, the erection of the stone (menhir) over it. This was to be followed by *perumpadai*, the great offering, perhaps with heaps of cooked rice (*perum-coru*, in other contexts) and other food, and by *valttutal*-praise or adoration, perhaps with song (and dance). The custom of worship and offering *perumpadai* or *perum-coru* for the first time, or periodically thereafter, in honour or memory of the dead will be clear from other references that are found in *Akananuru, Purananuru* and *Pattinappalai*.[1]

The decoration of the *nadukal* with flower garlands and peacock plumes with shield and lance, offerings including liquor and slaughter of animals, and worship are referred to in all Sangam works.

---

[1] *nal amark kadanta nanudai maravar*
peyarum pidum eludi, adartorum
pili suttiya pirangu nilai nadukal
vel unru palakai verru munai kadukkum
moli peyar te-e-am tarumar, mannar
kalippini-k- karaittol nirai kandanna
uval idu padukkai al uku parandalai
(*Akananuru 67: 8-14*)

vilai ambin viluttodai malavar
……………………………………
peyarum pidum eludi, adar torum
pili suttiya pirangu nilai nadukal
vel unru palakai verru munai kadukkum
veru varu takuna kanam
(*Akananuru 131: 6-13*)

vil-er valkkai vilu-t-todai marvar
val an padukkai-k-kadavut-penmar,
nadukal pili sutti, tudippaduttu
toppi-k-kallodu turu-u-ppali kodukkum
pokku arum kavalaiya pulavu naru aruncuram
(*Akananuru* 35:6-10)

il adu kallin cil kudi-i-cirur-p
pudai nadu kallin nat pali utti
nal niratti, ney-n-narai -k - koli-iya
mangul ma-p-pukai marukudan kamalum
aru munai irukkaittu ayinum
(*Purananuru* 329:1-5)

kiduku niraittu ekku unri
nadukallin aran pola
(*Pattinappalai* 78-79)

Most significant of all was the accepted conception that the dead person became the *nadukal*, as could be gathered from many contexts:

nanan talai ulakam arantai tunga
kedu il nal isai sudi
nadukal ayinan puravalan' enave
(*Purananuru* 221:11-13)

In the above poem, the poet Pottiyar remarked on seeing the hero stone installed in memory of his mentor Chola king Koperuncholan as:

"the broad world still remorse on the death of my protector adorned with praise of garland and became hero stone (*nadukal ayinan*)"

The cattle raid hero becoming himself *kal* is echoed below:

"The bereaved *kovalar* (shepherds) of many herds of cattle erected a *nadukal* in the rocky burial ground near the village for the hero, decorated it with sweet smelling flowers of the tall *vengai* (*Pterocarpus* sp.) and enclosed it by a fence of plaited palmyrah fronds. The hero is addressed as the leader on the fast horse (*kadu man tonral*) and extolled as having become the *kal*."

ur nani iranda par mudir parandalai,
ongu nilai vengai ol inar naru vi-p
pondai am tottin punaindanar toduttu,
pal an kovalar padalai sutta
kal-ayinaiye-kadu man tonral
(*Purananuru* 265: 1-5)

The method of exposure (*idu-tal*) for excarnation before interment is hinted at in the following case of a cattle raid hero who died in action:

paraludai marungin padukkai sertti,
maral vakurtu todutta sem pum kanniyodu
ani mayir pili sutti, peyar porittu
ini nattanare, kallum:
(*Purananuru* 264: 1-4)

In the stony part of the burial ground the body (in a pit) was covered over by leaves and boughs (*padukkai sertti*) heaped over it. The *nadukal* as usual, was decorated by a garland of red flowers intermixed with the sweet smelling *artemesia* leaves, crowned by a peacock plume and 'inscribed' with the name of the hero. *Patukkai* according to the dictionaries means a stone heap (*karkuvi*) suggesting a cairn, besides meaning concealment underground.

The *Tirukkural* too (distich 771) under the caption of *padai-c-cerukku* (boast or pride of the army) says,

ennai mun nillanmin tevvir palar ennai
mun ninru kal ninravar

"Oh enemies, do not stand in opposition to my leader; many are those who stood against my leader that have come to stand as *kal* (stone erection)".

The concept of the stone commemorating the dead or even personifying the dead person, and of the dead person becoming the stone itself and thereby divine, is emphasised in all contexts.

'........... peyar marungu arimar
kal erindu, eludiya nal arai mara atta
kadavul ongiya kadu-esu kavalai
(*Malaipadukadam*394-96)

"the forest (*kadu*) does not have the god blessed hero stone (*nadukal*) deeply engraved with the name of the hero"

'nanantalai ulakam arantai tunga
kedu il nal isai sudi
nadukal ayinan puravalan enave
(*Purananuru* 221:11-13)

"the broad world still remorse on the death of my protector adorned with praise of garland and became hero stone (*nadukal ayinan*)"

kalluyar neri-p-porunan
(*Padirrupattu* 67:22)

Thus from all the contexts quoted above, we learn that the location of the *nadukal* was the elevated, open expanse of stony ground (*parantalai*) with an alkaline (*uval*) soil[2].

Its erection is followed by decoration with a peacock plume (*pili-sutti*) with a spear (*vel*) planted near it along with the shield (*palakai*) and the name and fame (*peyarum pidum*) written (*eludi*) on it.

peyarum pidum eludi adartorum
pili suttiya pirangunilai nadukal
vel unru palakai verru munai kadukkum
(*Akananuru* 131:8)

"the hero stone decorated with the peacock plume with a spear planted near it along with the shield and the name and fame written on it"

The day-time worship (*nat-pali*) of the *nadukal* was by way of offering *bali* (food offerings), bathing it with good water, the stone smeared with ghee of good smell, burning by its side sweet scented incense that put forth large clouds of aromatic smoke (*Purananuru* 329:1-4).

The term *nat-pali* (*nal-bali*) may better be taken to refer to the day of death, or anniversary observed every year when such offerings were made. The *Akananuru* (35:6-10) states that the offering included large balls of rice (*turu-u*) and liquor that was brewed from fermented rice (*toppi-k-kal*), the ceremony being accompanied by the beating of a drum called *tudi*.

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[2] *nadu kal pirngiya vual idu parantalai*
(*Purananuru* 314:2-3)
uval idu padukkai al uku parantalai
(*Akananuru* 67:14)

Rice beer called *landa* is offered to the memorial stones by the Madiya clan of Madhya Pradesh (Sontheimer 1982: 87-99) and by the Rathava people in Gujarat (Haku Shah 1982: 102-116). The *Purananuru* (232: 3-4) further qualifies the liquor (*ari* - rice beer) that was strained through a *nar* or the sieve like *pannadai* (the meshed bract of the palm tree frond). *Purananuru* (306: 3-4) describes a village maiden worshiping the *nadukal* with folded hands. The practice of the bowman (the black bearded *maravar* of fierce looking eyes) sharpening his arrow (*pakali*) by whetting it against the standing *nadukal* (perhaps for luck in his hunt) lines referring to the engraved script on the *nadukal* (*kuyil eluttu*) and by a belief that the *nadukal* was haunted by the spirit (*pey*) of the dead is echoed in several verses[3]. These rites may also suggest the rituals adopted in the early stage of the memorial development chosen to those associated with the erection of Iron Age monuments and hero stones.

The discussion highlighted the distinct relationship between the Iron Age burial (*patukkai*) and Early Historic Burial (*nadukal*/menhir). The continuity of this tradition in the form of *virakals* (herostones) in the historical period, shows a continuity in the cult of honouring the dead. Further, this study clearly suggests that hero stones were installed with inscriptions during the Early Historic period. The present discovery aids in corroborating literary descriptions with material evidence.

Acknowledgements

We are grateful to Sri. Iravatham Mahadevan, eminent expert in Tamil-Brahmi, Prof. Y. Subbarayalu, Member of Indian Council of Historical Research, Prof. S. Raju, former Head of the Department of Epigraphy and Archaeology, Sri. Natana Kasinathan, the former Director of the Tamil Nadu State Archaeology Department, Dr. R. Poongundran, Former Registering Officer of the Tamil Nadu State Archaeology Department, Dr. S. Rajavelu, Epigraphist of Archaeological Survey of India, Dr. R. Kalaikovan, the Director of Dr. Rajamanikanar Historical Research Centre and many other scholars.

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[3] *irunkavin illa-p-perum-pun tadi*
kodunkan maravar pakali mayttena
marungul nunukiya pey em mudir nadukal
peyar payam padara-t-tonru kuyil eluttu
(*Akananuru* 297:5-9)

The same fact is repeated in *Ainkurunuru* (352:1-2),
viluttodai maravar vil ida-t-tolaindor
eluttudai nadukal anna

There is almost identical verse in *Akananuru* (53:10-12)
vilu-t-todai maravar villida vilndor
eluttudai nadukal in nilal vadiyum
arun cura-k-kavalai

again referring to the *Maravar.*
nal isai nirutta nanudai maravar

R.N. Kumaran and M.S. Kumaran, *Man and Environment* XXXII(1): 46-56 [2007].
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The Dolmens of Palani Hills, Tamil Nadu – Present Explorations

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Abstract

Megalithic monuments of Palani Hills are concentrated between 1250 to 1550 m AMSL. The line that runs North-South along the Neutral Saddle falls in this zone. Hills falling above this line are called Upper Palani Hills and those below this line are termed as the Lower Palani Hills. Megalithic burials are concentrated in the Lower Palani Hills, and scarce in the Upper Palani Hills. The main varieties of megalithic monuments found in these regions are dolmens, cists, pit-burials, urn burials and menhirs, where dolmens predominate. Their burials were mostly located in areas where raw material were easily available for their construction. The authors explored this region in order to have a better idea of stone working, transportation and construction of Megaliths, social organisation, engineering skills and technology.

Introduction

The Neutral Saddle bifurcates the Palani Hils into the Upper and Lower Palani Hils. Megalithic monuments (nearly 90%) are concentrated in the Lower Palani Hils as this terrain played a greater role in the formation of settlements. As this region is 1250-1550 m above AMSL, the altitude provides a congenial environment for the growth of forest products such as pepper and cardamon. These commercial products attracted the attention of early settlers.

Christian missionaries were the first to take an initiative in recording the archaeological potential of this region during the early part of the last century. Rev. Rosner (1937) brought the earliest archaeological monument to the notice of the academic world in 1906. Subsequently Anglade and Aiyyappan played a great role in investigating and recording the archaeological wealth of this region. Since then, archaeological monuments are being destroyed by the inroads of civilization. Irrespective of their isolation and inaccessible position, their size and location invariably attracted the attention of scholars and also treasure-hunters who plundered the archaeological wealth found inside these chambers. These treasure-hunters removed the capstone in most cases but did not disturb the structures. Nature also played some role in disturbing these structures.

Fortunately, several of them still retain their original features and give us an idea of the in mode of construction. Cist burials and urn burials are inconspicuous and often completely hidden in the thick vegetation.

Anglade (1928) discovered many megalithic sites and recorded them faithfully. Further he carried out excavations, which are presently displayed in the Senbaganur Museum at Kodaikanal. His path-breaking work drew the attention of other scholars. Aiyyappan (1940) excavated two cists at Vilpatti, which yielded a number of Black-and- Red ware currently housed in the Government Museum, Chennai. Allchin (1974) made a fair attempt to compare these with that of other megalithic sites. In the present survey, apart from twelve sites explored by the Anglade and others, the authors searched for other monuments, despite the inaccessible terrain. Some sites which need attention are Kathavumalai, Kottaikal-theri, Perumalai, Kumari-kunru, Sankarpethu, Adukkam Kamanur, Madathu-parai, Senbarankulam, Musirikai-kanal, Vanjadi-bothai, Solaikadu, Perumalai, etc. (Fig.1).

Local Tradition/Names

Megalithic sites are locally known as '*Pettu*', '*Valiyar madam*', '*Pandava kuli*', '*Pandavan medu*', '*Pandavan vedu*' or '*Pandavan kottei*'. Dolmens are generally termed '*Pettu*' which means 'to die'. The name '*Pandavakkuli*' may be a corruption of '*mandavar-kuli*' – the burial-pit of the dead, or of '*bhandakkuli*' – the pit in which the pots (*bhanda*, in Tamil *Pandam*) are buried. Or it may be a corruption of '*Palndavakkuli*' the burial of those who performed useless penance. This is owing to a belief in later times that Ajivakas or Jainas, whose penance was considered useless in the eyes of the followers of the Vedic religion; were buried in such pots. According to locals the

Received : 2-2-2007
Revised : 29-5-2007
Accepted : 11-6-2007

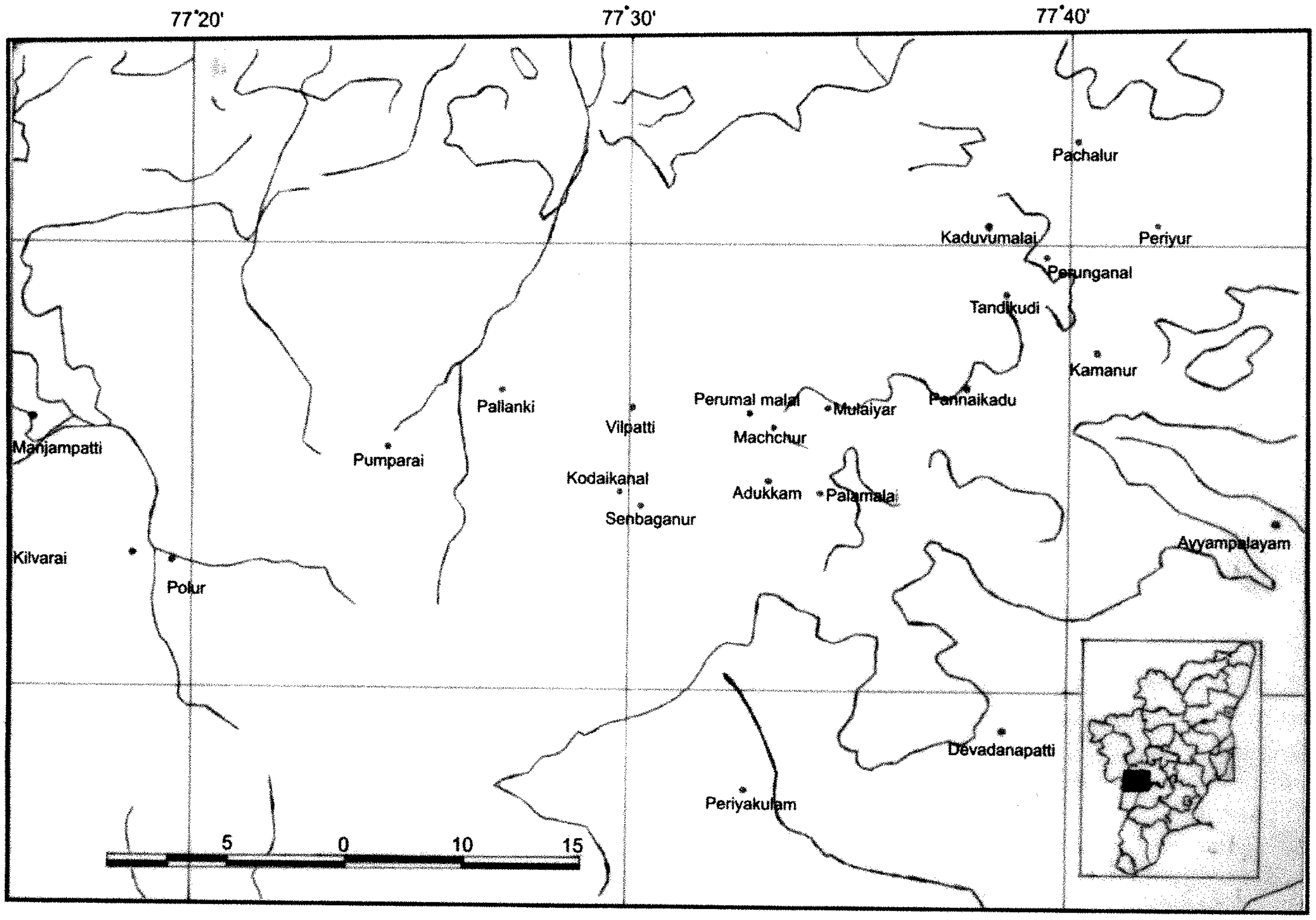

Fig. 1 Map of Megalithic sites in Palani Hills

term '*Valiyar madam*' refers to Vali of the Ramayana who stayed there with his troops. This may be the corrupt form of '*Kurunguppattadai*', meaning 'hoards of monkeys' which is again a corruption of the old name '*kurakkuppadai*' or '*kurakkuppattadai*' where '*kurakku*' means 'to lower' or 'bury'; '*padai*' means 'to bed or on which one rests; i.e. a sepulcture or tomb lowered into the earth. This commonly refers to stone cists.

Urn burials were also known as '*Madamadakkattali*', '*Mudumakkal-tali*' or '*tal*', where the former is the corrupt form of *Mudumakkal – tali* meaning urns or receptacles (*tal*) in which the ancients or ancestors are buried. This name is found in early Tamil works from the 3rd century B.C. to the 12th century A.D. The word *tal* itself indicating a large receptacle for burial, is evidently derived from *tal* which mean 'to lower into the earth; or 'to bury'; and the original sense in which it is used as a vessel that is buried (Srinivasan 1946: 9-16). The name '*Sudukattu-parai*' means 'the cremation ground' and '*Pandavan vedu*' refers 'the house of the Pandavas during their exile'. The term '*Pandavan kottei*' (fortress) refers as the size of the capstones, which are of varying dimensions, 2.99 x 2.16 m to 3.84 x 3.17 m with a thickness of 30 to 40 cm. They were raised to a height of 1.52 x 1.83 m to rest on the orthostats; a very difficult task. This is one of the reasons why the building of dolmens was attributed to the Pandavas of Mahabharata fame.

Architecture

The dolmen is a rectangular box, which was built normally of six slabs, one lying horizontally on the bedrock serving as a floor slab. Around this base, the slabs stand directly on bare rock and were placed in a clockwise or an anti-clockwise direction with uneven surfaces on the top, which in turn supports, the capstone placed above (Fig. 2 see cover 3). The capstone slopes allowing drainage of rainwater. In most dolmens, the orthostats placed at the entrance is missing. This is inferred from one dolmen, where an orthostat was broken to create an entrance into the chamber. In some cases, the side wall of the bigger dolmens is built of two or three orthostats placed one above the other or on the sides. In rare cases, instead of orthostats walls were constructed.

Generally the dolmens were erected on rocky slopes; and rarely on plains. They were in groups, but single dolmens are also encountered at Korai Kombu and in Madathu parai. Dolmens are constructed in two or three rows; normally three dolmens occur in a row with in an enclosure wall. The group contains a minimum of two to a maximum of twenty-eight chambers, but mostly are six to ten in number. Sometimes they occur in only one row as seen at Idunjakuli complex between Tandikudi and Kadavumalai. The size of the chamber is determined by the size of the floor slab. The gaps between the chambers, the orthostats and the enclosure walls were tightly packed with cairn fulling upto the level of the capstone to prevent any outward tilting of the orthostat. The inward tilt is prevented by the interlocking system of the chamber and also by filling with mud as noted above. In Sembarankulam, it is inferred that the builders used stones from the river nearby as they are rolled. In some cases larger dolmens were filled with cairn stones while smaller one were filled with soil.

Orientation

Different orientations of dolmens were noted. The available rocky slopes determined orientation of the dolmens. In the case of two dolmens, they were parallel with openings on the same side. If they were placed in a circular form with the entrance facing the centre. If they were in a row, all face the same direction. In rare cases, they were placed facing different directions.

Enclosure wall

The enclosure wall is a special feature of dolmens of the Palani Hils (Fig. 3, see cover 3), which were made of dressed stones of regular courses of no fixed sizes, adjusted without any trace of binding medium. They are usually rectangular, square, circular and trapezoidal in shape and rarely apsidal and of the Shiva-linga type. If the complex was square, rectangular or trapezoidal then flat rectangular dressed stones were used. In the case of a circular wall; triangular shaped stones, with the outer or broader edges of the blocks trimmed in a semi-circular forms were used. Such examples are found at Sankarpethu. At Kumari kunru, triangular stones were kept alternatively with the pointed tip inside, creating it a circular enclosure wall. The walls were raised up to the level of the dolmen with six to eight courses. The wall and back slabs of the dolmens go hand in hand and the average length of the wall varies from 6 to 11 m in length with maximum height of more than 2 m. At Sembarankulam, instead of stones, orthostats were used to raise the enclosure wall.

The Shiva-linga type of enclosure wall is unique and found for the first time in 3rd complex at Madathu parai. The dolmens here were laid in three rows of two dolmens each in horizontal fashion and the key dolmen was laid in the vertical fashion in the so-called *pranala* area.

Capstone

The size of the capstone is directly proportional to the size of the dolmen; they are not uniform at all points and bear only the traces of crude hammer dressing. The gap between the orthostats and the capstone is cleverly wedged with small stones that allow the capstone to rest perfectly upon the chamber. Generally, one capstone covers a chamber and sometimes two capstones (Fig. 4) cover a large chamber. In a very rare case, a capstone covers two adjacent chambers.

Stone working/Transportation

The most interesting aspect is that of the transportation of heavy stones from the quarry to the site. Only enormous effort and skill of an organized society that had the knowledge of stone working, transportation and constructional methods could achieve these tasks.

According to Anglade (1928), 'as neither of the stones used for the walls nor on the slabs of the chambers is there any mark of cutting or dressing with any instrument, the dolmen builders seems to have depended exclusively on the blocks found at hand and this may explain why these dolmens are invariably erected on rocky ridges or slopes or immediately below a large expanse of rock'. Further, he opines that,'the slabs of any dimension may be detached from the surface of the rock due to the natural process which could be easily removed by means of crowbar'. This may refer to the early type of burials. In recent explorations, at many places, chisel marks were found not only on the orthostats but sometimes on the capstones as well. The dressed stones of required sizes were used to raise enclosure walls and clearly attest that they knew the art of planning and architecture. The iron chisel (Fig. 5) found in one of the dolmen further attests to their mastery over iron technology.

As mentioned, they quarried stones from neighbouring hillocks. The evidence of the transportation (Fig. 6) is noticed at Vanjadi bothai. Here they transported big stones using a pulley wherein smaller rolled stones were laid under the larger ones and were pulled to the required site.

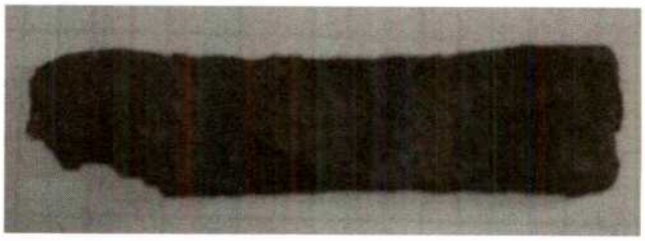

Fig. 5 Iron chisel, Tandikudi, Tamil Nadu

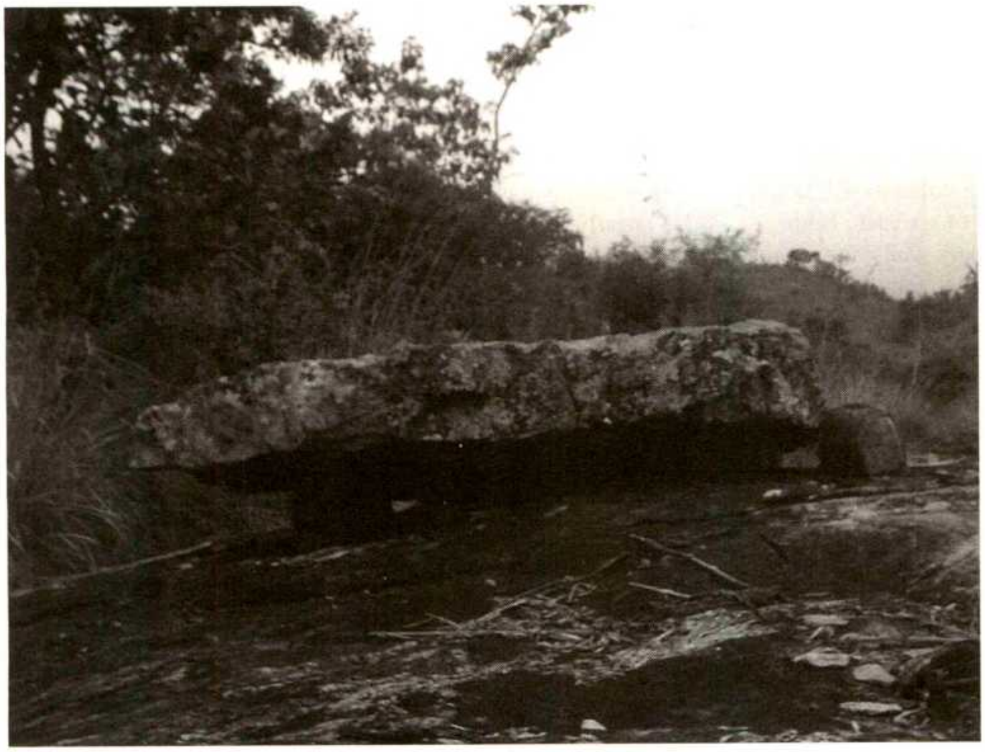

Fig. 6 Transportation of orthostats, Vanjadi Bothai, Tamil Nadu

Recent Explorations

Kathavumalai

Kathavumalai lies on the northern side of Tandikudi, where one has to climb 5 km up hill to reach the site. The nearest village is Aracankodai, and the Alinji odai, a tributary of River Kallar flows nearby. At the back of the hillock, a group of nine dolmens, locally known as Pettu, occur in a circular fashion, in a radiating figure enclosed by a circular wall. All the dolmens face the centre with a wide opening. The gaps between the orthostats and capstone are cleverly wedged with small stones, allowing the capstone to rest perfectly upon the chamber. The enclosure wall and the rear orthostat of the chamber go hand to hand. The perfect construction of the whole structure clearly suggests that they were built at the same time.

Kottaikal-teri

Kottaikal-teri lies in the Kallar Reserve forest, around 5 km to the north and uphill of Tandikudi. The seventh complex with twenty-seven dolmens is important, because of its larger size and almost undisturbed condition. The enclosure walls of these dolmens were either rectangular or circular. If the wall was rectangular then square dressed stones were used; whereas where circular in form triangular stones were used. The broader or outer edges of the triangular blocks were trimmed in a convex fashion, which in turn helped raise a perfect circular wall. These walls were raised up to the height of the capstone or dolmens. Generally, one capstone was placed on a chamber, but in long chambers double capstones were used.

The whole structure was built in such a manner that the gap between orthostats and the walls were tightly packed with cairn stones. On close observation, the chambers yielded the sherds of Black-and-Red ware, Black slipped ware and Red ware. An interesting feature noticed at the site were ridges like marks on the boulders, clearly indicating methods by which the stones were quarried.

Idunjakuli

Idunjakuli lies on a hill between Tandikudi and Kottaikal-teri in the Kallar Reserve forest. A single complex with two dolmens facing south was enclosed in a circular wall with a diameter of 4.80 m.

Perunkanal

Perunkanal lies about 4 km to the east, between Tandikudi and Periyur in the Kallar Reserve forest. A single complex of four dolmens was found enclosed in a circular wall of dressed triangular stones. The dolmens do not face any particular direction but are built one after another along the inner edge of a circle. Only two courses of enclosure wall were noted and the capstones were missing.

Mundiyalai pettu

Mundiyalai pettu lies 1 km west of Perunkanal, 3 km east of Kallar, 2 km north of Kottaikal-teri and 1 km south of Kulappalam. Here two relatively less disturbed complexes were found. The first one contains two dolmens facing west and the second contains twelve dolmens. All dolmens are large and were laid in two rows of six each. Both complexes were enclosed by periphery walls; the former with a circular wall 6.40 m in diameter and the latter with a rectangular one of 11.89 x 10.06 m.

Tandikudi

Tandikudi, one of the major villages in the Palani Hills was situated northeast of Vattalakundu in Kodaikanal Taluk. This village is situated 1342 m above AMSL and can be approached either from Ayyampalayam or from Pannaikadu. The village is surrounded on four sides by two hills, Kathavumalai and Arungkanalmalai.

The groups of dolmens in eight complexes locally known as Pettu, were found on the way to Murugan temple, when approached through the Coffee Board. All complexes were more or less disturbed. It is inferred that the available rocky slopes in the built up area determined the orientation of the dolmens and it is also observed that the openings are found along the lower end, which indirectly helps in preventing rain water percolating directly into the chambers. These complexes were enclosed either by circular or rectangular enclosure walls. Nearly thirty dolmens, Black- and- Red ware, Red ware, Black Slipped ware and an iron chisel were found.

Kumari Kunru

Kumari kunru lies in the Kallar Reserve forest on the bridle pathway between Tandikudi to Periyur village. The site is locally known as Thampattampurai. A complex of four dolmens facing east was raised on the slope of the rocky surface. An interesting feature was the circular enclosure wall made of dressed triangular stones laid alternatively with pointed tips inwards. Chisel marks were noted on the orthostats.

Kamanur

Kamanur lies on the Vattalakundu – Tandikudi road around 1220 m above AMSL and lies at a distance of 2 km northwest of Tandikudi. The only surviving complex lies on the rocky surface of seven dolmens, which faces east with a circular enclosure wall. Here, more than four orthostats were used to raise the dolmens. Single orthostats were used on the western side whereas on the northern and southern sides, more than two orthostats were placed one after the other.

Musirikai-kanal

Musirikai-kanal lies 2 km south of Kodalankadu, 4 km north of the Vatalagundu road; and 2.5 km west of the road from Pannaikadu to Tandikudi. River Maruthanadi, flows 500 m away from the site. Of the two complexes, the second one is quite interesting, because it consists of nearly twenty-eight dolmens, four rows of seven dolmens each. They were enclosed in a common rectangular enclosure wall. This complex is covered by dense vegetation.

Mangalam Kombu

Mangalam Kombu lies 4 km from Tandikudi to Vathalakundu. Here more than ten cist burials were found in a land, which belongs to a private landowner.

Mangalapuram

Mangalapuram lies 3.5 km southeast of Tandikudi to Mangalam Kombu from where the route bifurcates to Kamanur. The dolmens were destroyed beyond recognition but disturbed cist burials were found where the villagers used the orthostats and the capstones for their building activities. On studying the huge amount of materials used by the villagers, it can be inferred that hundreds of cists burials must have been present here.

Pali parai

Pali parai lies on the way from Thadiyan kudisai to Kamanur, 3 km from the former and 5 km from the latter village. Two complexes, both damaged beyond recognition by treasure hunters, were identified here.

Thadiyan kudisai

Thadiyan kudisai lies 9 km southeast of the Tandikudi on Vattalakundu road. This site is important as it connects these sites; Adalur–Pandrimalai and K.C. Patti-Pachchalur-Ottanchatriam. A single complex with eight dolmens, completely disturbed, with a circular enclosure wall has been found here. Apart from this, cist burials were also noticed here. One of the disturbed burials has a trapezium-shaped porthole, and the capstone was chiselled cleverly in the way that it perfectly rests onto the orthostats without any gap.

Vellarikarai

Vellarikarai lies 3 km from Manjalparapu on the Vattalakundu road. Partially disturbed cist burials were found in this village. Tribal population of Paliya and Pullaiya live here.

Vanjchadi Bothai

Vanjchadi Bothai lies just opposite Karumparai, on the left side of the road that leads to Solaikadu. A single complex of five chambers with in a circular enclosure wall was noted. The transportation of a capstone from a near by quarry is highly significant. Pulley system was used to move the stones.

Karum Parai

Karum Parai lies on the main road of K.C. Patti to Adalur on the route to Solaikadu and 1.5 km away from the road. Pachchalur is situated 5 km northwest and the site is surrounded by Kathavumalai and Perumalai to the west and south side respectively. A single complex with nine dolmens has been found here. All dolmens were laid in circular fashion, as a radiating figure with cairn packing. A periphery wall encloses the whole complex where triangular stones were used to erect a perfect circle with a diameter of 8.84 m.

Vendran malai

Vendran malai lies on the way to Adalur on Solaikadu road, 1 km from Karumparai. Around 3 km to the south, a partially disturbed single complex with nine dolmens were noted. These were placed alternatively, as major and minor dolmens, in a radiating figure. In the centre where a minor dolmen was placed. The major dolmens are rectangular in shape, whereas the minor ones are square in shape. The orthostats are irregular flat and rectangular; and the capstones are domical or rectangular in shape. The whole complex was situated on the slope of the hill and was enclosed by a circular wall.

Ozhugumalai parai

Ozhugumalai parai lies 10 km to the south of Kanniwadi plains and nearly 5 km from Vendran malai, and 4 km north of Sengadambur. Here two complexes were found, the first one contains seven dolmens, which faces the centre, and rectangular, undressed stones were used for the orthostats and capstones.

In the second complex, there were nine dolmens, three in two rows and two are laid on either side of the rows and one minor dolmen behind the first row. The dolmens in rows face each other. The capstones and orthostats were very large in size. The dolmens in the centre were comparatively larger than those on the sides. In one of the dolmens, undressed stones were used as orthostats, as was also the case in the adjoining dolmens. A circular wall encloses both complexes.

Solaikadu

Solaikadu lies between Adalur and Pandrimalai, around 1 km before K.C. Patti via the Adalur road. Hundreds of dolmens are scattered over wide area. Of nearly six complexes, noteworthy was one complex enclosed by a modern wall with a *gopuram* and worshipped as a temple, locally called as Senbhaga-nachi Amman temple. The idol of the goddess was placed inside the dolmen.

Vannan-thurai

Vannan-thurai lies 0.5 km along the Solaikadu on Pandrimalai road. Here, a fully disturbed single complex with a circular enclosure wall was found.

Aruvimalai

Aruvimalai lies 3 km east of Adalur on the Adalur-K.C. Patti road, 3 km west of Marumalai and 15 km from the Tandikudi pathway. Two complexes were found here. In the first complex, ten dolmens with two minor dolmens were laid in a circular fashion with a circular wall of 11.50 m in diameter. The second complex with six dolmens were laid in two rows and enclosed by a rectangular wall, measuring 8.53 x 7.62 m.

Pandrimalai

Pandrimalai lies 5 km west of Adalur. The village was well-planned with *toranas* at the four cardinal directions, with the main entrance on the eastern side. Uprooted orthostats were found, but not a single dolmen could be identified. The site was totally disturbed.

Thoni malai

Thoni malai lies 1 km from Perumalmalai, 7 km west of Kanniwadi, 6 km north of Pannaipatti kottai and 16 km southeast of Pandri malai. At from different places, single dolmens were located. The peculiarity of these dolmens was that instead of orthostats, stones of irregular sizes were used to raise the wall. Local people worship these dolmens by keeping terracotta figurines inside them.

Korai Kombu

Korai Kombu lies 1 km west of Kuppamapatti, 3 km north of K.C. Patti and 4 km east of Kavaiyakadu. A total of four complexes were found here. The first one had six dolmens placed in two rows which were fully disturbed, the second one was totally disturbed and the orthostats were used to built a temple 'Karumari Amman Temple' for a local goddess. The third one deserves mention. This partially disturbed complex had only one chamber with a large enclosure wall. The mode of construction indicates that an important person might have been buried here. The fourth, with four dolmens, was less disturbed and fully packed with cairn stones. All complexes were enclosed by a wall, the first three with circular walls, and the last with a rectangular one. In the same village, more than hundred undisturbed cist burials were found in private land (Mudaliar Garden).

Kombuthi Malai

Kombuthi Malai lies in the Waterfalls Estate, 2 km east of K.C. Patti and 2 km north of Periyur. This partially disturbed single complex with eight dolmens was laid with three each in two rows, with single one on both sides of the rows. It was enclosed by a circular wall.

Periyur

Periyur lies on the opposite face of Aruvimalai. Dolmens (three complexes) and cist burials were found on the right side of the road, and the *mandapas* of a medieval temple were raised over the dolmens.

Manikattan Parai

Manikattan Parai lies on a pathway between Periyur and K.C. Patti, 1 km west of the former and 2 km south of the latter. A single complex with two dolmens was found here, with a circular enclosure wall, which was fully disturbed.

Kuttai-Parai

Kuttai-Parai lies 1 km west of Kuppamapatti facing Kathavumalai. A fully disturbed single complex with a circular enclosure wall was noticed here.

Kavaiyakkadu

Kaviyakkadu lies in between Nerimalai and Korai Kombu, and 4 km along the K.C. Patti – Thadiyankudisai road. A lone complex was encountered here with six chambers. The chambers roughly measure 4.57 x 1.83 m (outer dimensions) and 3.35 x 1.37 m (inner dimensions). This partially disturbed complex was enclosed with in a circular wall.

Perumalai

Perumalai lies 1 km east of Kavaiyakkadu and just opposite Koraikombu on the way to Karupannasamy temple. A single complex was found here enclosed in a perfect circular wall of seven courses with a diameter of 11.28 m, which contains eleven dolmens laid in two rows along the enclosure wall. Chambers have a maximum height of 1.83 m.

The special feature noticed was that instead of an orthostat, chiselled stones were used as a wall in one of the chambers. Barely 10 m east of this complex, a semi-circular enclosure wall with five stone slabs placed upright (crude anthropomorphic figurine?) was found. This place may have been used to perform the last rituals for the departed before into the dolmens.

Nerimalai

Nerimalai lies 1 km east of Perumalai, and one fully disturbed complex was encountered here.

Maliya-Parai

Maliya-Parai lies on the way to Pachchalur. A completely disturbed complex was found here, where local people worship broken orthostats, as their deity.

Talai Kodai

Talai kodai lies 3 km between K.C. Patti and Pachchalur, via a diversion at Nadupatti to Sembadi-Uthu. The site is 5 km north of Pachchalur, 2.5 km east of Paraipatti, 1 km south of Uthuppatti and 5 km south of Kathavumalai. Here, a single complex with nine dolmens laid in two rows, four facing west and five facing east, enclosed in a circular wall were found.

Mandrakkalvoy

Mandrakkalvoy locally known as Silamparai lies 3 km. from Nadupatti on the west of Uthupatti road in between Sembadi-Uthu and Nadupatti Peruvu. Here, cist burials were found in large numbers.

Kavappatti

Kavappatti lies 1 km north of Sembadi-Uthu, where a fully disturbed single complex was found.

Sembadi-Uthu

Sembadi-Uthu lies 3 km north of Silam-Parai on the road to Uthuppatti. Here a single dolmen was found at the entrance of the village, and other dolmens in the complex were completely disturbed.

Pallathu Kalvoy

Pallathu Kalvoy lies 5 km from Pachchalur. The site is not famous for the dolmens, but for hundreds of cist burials. Most cists have been uprooted during the cultivation and the orthostats were used for the building a fortification wall. Five escaped the vandalism.

Madatthu Parai

Madatthu Parai lies on the road between Pachchalur and Sembarankulam, 3 km south of Kathavumalai. A group of seven complexes, three on the right and four on the left of the road were found. Of these, the second, fourth and sixth complexes are noteworthy. In the second complex, there were seven chambers placed in a circular form with four major dolmens and three minor dolmens. The former group was filled with cairn packing and the latter were filled with soil and closed on all sides. The gaps between them were also filled with cairn packing. The first major dolmen is very large and extends up to the centre, where all faces different directions.

The fourth complex was interesting and differs from the rest of the dolmens. The first, key dolmen was placed on an elongated circular entrance and the other six were placed in two rows of three dolmens each, within the circular enclosure wall. In the sixth complex, three dolmens were placed inside the circular enclosure wall, where two dolmens were placed in two rows and the third one parallel to these rows. The notable feature is a second dolmen where a small orthostat was placed inside the chamber, and bifurcates the inner space, making it transcepted.

Perumalai Parai

Perumalai Parai lies on the way to Pachchalur to Sembarankulam, i.e. 1.5 km upward on northern side and 2 km from Madathu Parai. A single complex was found with seven dolmens laid in two rows facing each other. A circular wall with a maximum diameter of 9.80 m enclosed this complex, which is fully disturbed.

Sembarankulam

Sembarankulam lies 7 km from Pachchalur and 3 km south of Kathavumalai. A huge complex was found in the GRT estate, 1 km west of Sembarankulam. The River Kuttar, flows 100 m west of this site. The complex was not found here as in other cases, but on the plains. Another feature is that the enclosure wall was raised using orthostats. In this complex, thirteen dolmens were placed in two rows with eight smaller dolmens in a row, four larger ones in another row; and one in the centre. The complex is fully packed with cairns and it is inferred that these cairn stones brought from the river nearby, because they were rolled.

Pattiya-kadu Perukampatti

Pattiya-kadu Perukampatti lies 2 km north of Sembarankulam to Pattiya-kadu and 1 km from Porparai. This partially disturbed single complex with seven dolmens laid in two rows has been encountered here, and was enclosed by a circular wall.

Pattiya-kadu

Pattiya-kadu lies 2 km southeast of Perumpallam, 5 km east of Kathavumalai, and 15 km east of Ayakudi. This single complex with nine dolmens laid in two rows facing each other was enclosed by a circular wall with a maximum diameter of 11.40 m. All dolmens were more or less disturbed.

Porparai

Porparai lies 400 m north of Pattiya-kadu, where a single complex was noticed with a circular enclosure wall. The complex is fully disturbed and due to dense vegetation, only one dolmen was found in undisturbed condition. The maximum diameter of the wall was 6.50 m.

Perumpallam

Perumpallam lies on the Vadakavunchi road where it is 6 km northwest of Vadakavunchi 8 km west of Tandikudi, 2 km east of Pattiya-kadu and 10 km east of Pachchalur. A single complex of seven dolmens, in a radiating figure, facing the centre was enclosed by a circular wall with a maximum diameter of 8.06 m. Only two dolmens are intact.

Adukkam

Adukkam, a small hamlet, lies near the village of Palamalai. Ten megalithic complexes, were found in two places; Samakattuppallam and Thuppakkimalai. Noteworthy were the second and the third complexes. In the former, microlithic tools of quartz and chert were found, comprising mainly blades, burins, points scrappers, etc (Fig. 7). The availability of both finished and unfinished tools, fluted cores and raw materials clearly suggest that they were locally manufactured. At this stage, it was very difficult to suggest any chronological frame for these tools. In the latter, this was the only complex, with a square shaped enclosure wall and dolmen facing different directions.

Sankar-Pettu

Sankar-Pettu lies between Tandikudi and Pannaikadu; opposite Etiroliparai (echo-rock) located 1 km from Pannaikadu. Of the five complexes, the fourth one is worthy of mention, and contains six major and six minor

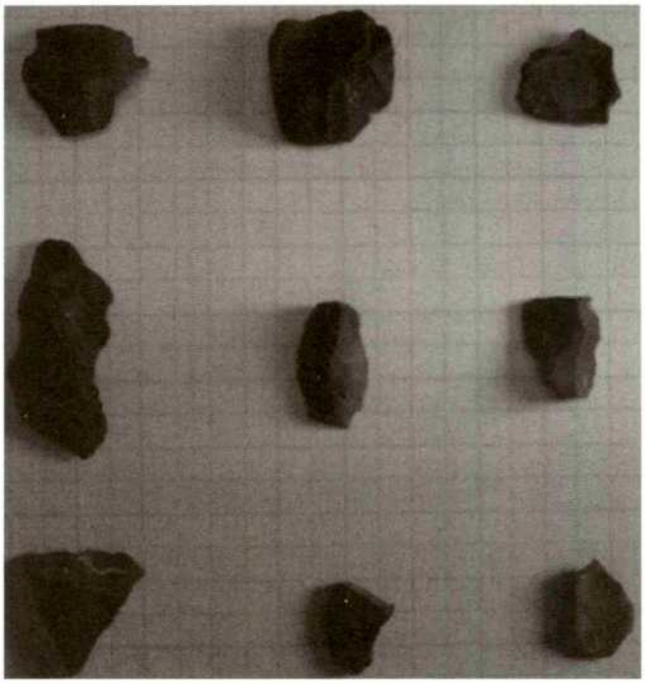

Fig. 7 Microlithic tools, Adukkam, Tamil Nadu

dolmens placed alternately inside the enclosure wall. These dolmens form a radiating figure facing the centre, where a minor dolmen was constructed. The gap was filled with cairns. The diameter at the inner edge of the circle is greater than the diameter near the centre. This situation did not allow the megalithic builders to erect the chamber in a perfect rectangular or square shape. To overcome this space problem, they narrowed the entrance, which resulted in a trapeze-shaped chamber. This complex was well-planned and the measurement of the chambers and capstone were almost uniform.

Valangkulam

Valangkulam lies on 35th km between Vathalagundu and Kodaikanal, and 4 km south of Moolaiyar. Of the two complexes found here, the first one was circular with a double capstone and orthostats with twelve dolmens placed along the periphery facing different directions; and one minor dolmen at the centre. The gap between the dolmens were filled with cairn stones.

The second complex is situated 250 m away from the first, opposite Kumbariyur. The rectangular complex was partitioned into three chambers by raising a wall and contains thirteen, six and six dolmens, respectively. Apart from the double capstones and orthostats; double chambers were also noticed. The gaps inside and outside the dolmens were tightly packed with cairn stones.

Tharisakadu

Tharisakadu lies 1.5 km south of Valangkulam. Three complexes were noticed here, whereas in the first one, only three dolmens remain. The second complex, 10 m from the first is very huge, both in shape, size and number. Due to heavy dense vegetation only eighteen dolmens were identified. It is necessary to mention here that a single large capstone covers an adjoining chamber. The third rectangular complex, 10 m away from the second was completely destroyed.

Valiparai-Kadaisikadu

Valiparai-Kadaisikadu lies 3 km north of Tharisukadu, where Talaiyur, Manjalar dam and Palamalai are situated to the south, east and west. The single square complex with twelve dolmens was found situated on the eastern slope of the hill locally known as Paliparai.

Poolathur

Poolathur lies 26 km from Tandikudi on the Vathalagundu to Kodaikanal road, and one has to take a diversion around 25 km towards the north. The site is locally known as Kuran-Urutu-Peetukumbu and lies 3 km east of the village. Ovi Odai flows 500 m away from the site. A single complex with a circular enclosure wall of 10 m diameter was noticed. The six rectangular and square-shaped dolmens were found in varying sizes and were filled with cairn stones, both inside and outside.

Ambavi (pulam)

Ambavi (pulam) lies 1 km southeast of the Kuran-Urutu and near Nandangkarai Padai. An undisturbed cist was noticed with an outer diameter of 6 m and inner diameter of 5.40 m. As this site was situated in a dense forest, a cist could be found here.

Manthirai Villapu

Manthirai Villapu lies 2 km from Poolathur. Manthirai Odai flows 1 km south of the site, which was locally known as Villapu-nachi. Here, for the first time, six menhirs were found on a hillock in a semi-circular fashion. The stones were set right over small square platforms with maximum heights of 80 cm, 75 cm, 65 cm, 70 cm, 75 cm and 68 cm, respectively.

Manthirai-Kulam

Manthirai-Kulam lies 500 m from the Manthirai Villapu where two menhirs were noticed in private land. They face north-south and measure, 60 x 65 cm and 75 x 90 cm, respectively.

Kuthirai Kallaru

Kuthirai Kallaru lies 3 km from Poolathur and 1 km south of Manthirai Villapu. Manthirai Odai flows just near the site. Although the site was partially disturbed, this single complex of nine dolmens was placed in two rows with huge orthostats and capstones, and enclosed within a circular enclosure wall with a diameter of 11.30 m.

Conclusion

The burials and funerary rituals play a crucial role in understanding cultural traits that prevailed in ancient times. The homogeneous nature of the burials throws much light on regional variations.

During recent explorations, it was noticed that half of the dolmens were in a ruined condition, a mere heap of stones, which indicates the existence of a complex. In most places, the stones were removed and used by local people to build their houses or compound walls; and even a fort inside the forest, and in rare cases construct a temple over the dolmen itself. One of the dolmens was even changed into a garbha-griha of a local goddess. When Anglade (1925) surveyed this area, most dolmens were damaged by road construction and were used to repair walls and culverts. This is one of the reason that sites and burials identified by him were untraceable during the recent exploration.

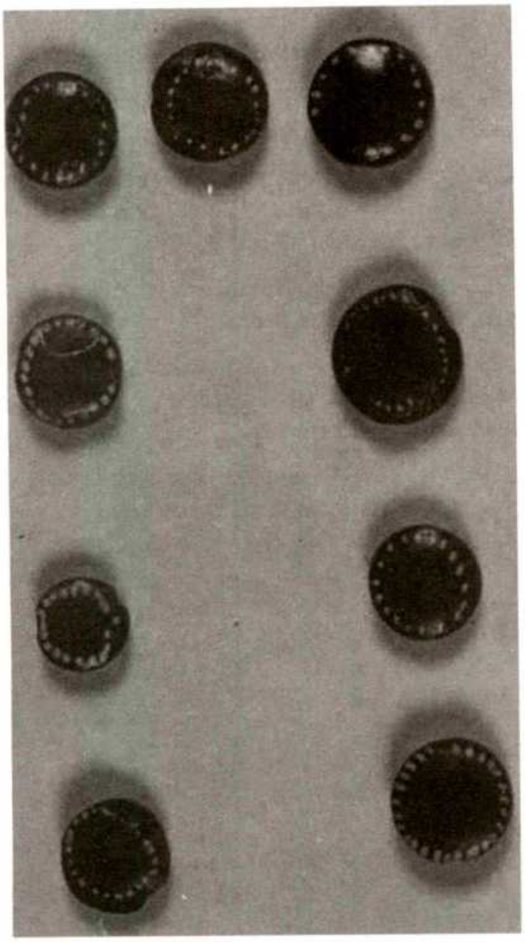

Fig. 8 Etched carnelian beads, Tandikudi, Tamil Nadu

Most burials were near water sources; and the average rainfall of this area is 165 cm/annum. So there was no need to raise bunds to store water for irrigation or for other purposes. Hunting and gathering was the main activity. The pottery found in the excavations at Vilpatti, Tandikudi, etc., as well as in exploration, clearly shows that they were skilled in pottery making. This indicates a high degree of imagination and artistic sense. At the site of Perumalai, near a burial complex, a semi-circular wall with crude anthropomorphic figurines (?) points to some funeral services for their departed souls.

The people were well versed in stone cutting and metal technology. Quarrying, lifting, transporting and erecting these huge stone slabs and boulders certainly indicate that they had knowledge of petrology and technology. Their engineering skill could be seen in their perfect plan; such as the ground preparation, chiselling and flattening surfaces, dressing the slabs, placing the floor slab, erecting the orthostats, covering with capstone; etc. Further, they preferred an elevated area for their cemeteries, so most of the dolmens were raised on the slopes of the rocky surface. The reason behind this may be to utilize unproductive areas for a better purpose and for quarrying of stones in the mountains and hillocks. This led to varied orientations of dolmens, owing to the available rocky slope which determined and restricted the orientations.

Regarding the transcepted variety, Anglade (1928) is opined that they served the purpose for storing grains or dry fruits. He found these 'boxes' in all the groups and, the square corner divided off by a vertical slab and perhaps intended as a substitute for them. It is a remarkable coincidence that such corners are invariably found at the narrow end of the dolmens, and on the side, which was opened. During recent explorations, this type was encountered at Madathu Parai and at Tandikudi.

Religious belief may have influenced the layout of dolmens and the enclosure wall. They preferred a circular layout. The unique 'Shiva-linga type' wall was encountered here, which clearly suggest some sort of fertility belief. As far as the plans of the dolmens are concerned, they are arranged in fine alignment, with space left between dolmens. If they were not arranged in a row, as in some cases, they utilized the available space to the maximum extent without disturbing the general harmony. The dolmens arranged in rows show not only their clear calculations and measurements but also their aesthetic sense. The dolmens arranged in a circular and semi-circular fashion, as a radiating figure, where in all the dolmens face the centre; resembles a wheel and axis, which again indicates their fertility belief. The in-depth study of the planning and architecture of this type may reveal their original ideas behind these alignments.

During the course of exploration, the chisel and other typical megalithic wares, etched carnelian beads (Fig. 8) were also collected from one of the disturbed cists at Bommaikadu near Tandikudi. In size, shape and design, the beads resemble from the Kodumanal excavations.

Acknowledgements

We thank Dr. Y. Subbarayalu and Dr. K. Rajan, for their valuable advice and guidance. Special thanks to are due to Mr. Adiyaman of the Under water Archaeology wing, Tamil University, Thanjavur, Mr. Stephen D. Samuel, Deputy Director, Coffee Board, Tandikudi and Mr. S. Mohanasundaram of Tandikudi, who accompanied us throughout our explorations. His extraordinary knowledge on local geography helped us in several ways to identify some important archaeological sites in this region. We also express our sincere thanks to Shri K. Bahuleyan, Stenographer, Archaeological Survey of India, Excavation Branch – V, Vadodara and Shri Anand Kumar Maurya for their help in one or other ways.

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R.K. Mohanty, *et al.*, *Man and Environment* XXXII(1): 57-66 [2007].
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A Preliminary Report of the Archaeological Investigations at Sisupalgarh 2006

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Abstract

Sisupalgarh, a walled city of the Early Historic period in eastern India, represents one of the best-preserved urban centres of its kind. Excavations in 2006 were undertaken on the northern portion of the site in two areas: an open excavation of domestic architecture adjacent to the rampart, and a deep sounding that revealed over six metres of cultural deposits before reaching natural soil. This excavation was complemented by the non-invasive methods of geophysical survey, which revealed the presence of substantial linear features (possible roadways) intervening the site from two of the rampart's formal gateways.

Introduction

The ancient Early Historic city of Sisupalgarh in Orissa consists of a large walled fortification area surrounding an area of ancient urban habitation over one km^2 in size. Architecture within the site includes a structure of monolithic laterite pillars at the centre, numerous tanks and stone-lined ring wells, and extensive evidence for domestic habitation throughout the walled area. B.B. Lal in 1948 began the research at Sisupalgarh (Lal 1949, 1991). Recent investigations consist of a systematic surface survey programme (Smith 2002a, 2002b) and excavations starting in 2005 (Mohanty and Smith 2005, 2006a, 2006b). The fieldwork described here is from the second season of excavation in January and February 2006 jointly conducted by R.K. Mohanty and Monica L. Smith under a permit from the Government of India and in association with the Archaeological Survey of India.

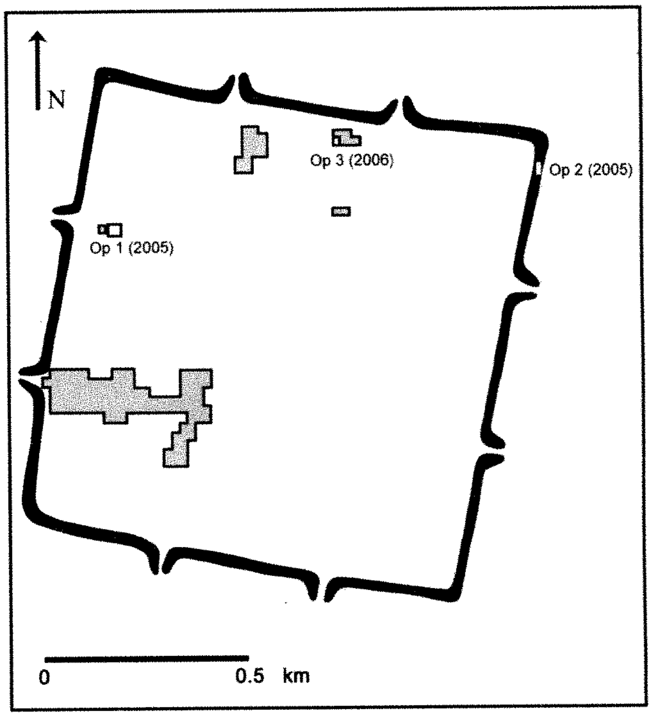

Fig. 1 Location of excavated areas and geophysical survey (shaded) within the fortification

Excavations in 2006 were undertaken in two areas within 100 m of the interior of the central portion of the northern rampart: an open excavation in an area of domestic architecture, and a deep sounding that reached natural soil (Fig. 1). Our goal was to excavate domestic structures in which we can use artefactual, architectural, faunal, and botanical data to evaluate how households were organized and how they participated in successively larger social configurations including neighbourhood and urban-level arrangements during the Early Historic period. In both of the excavated areas, we recovered a very high density of pottery along with faunal and botanical remains. The team also undertook geophysical research to evaluate subsurface deposits in the northern and southwestern portion of the walled area of the site. Specialized studies on all of these materials are ongoing, but we present here the preliminary results of the 2006 fieldwork.

Received : 13-3-2007
Revised : 15-5-2007
Accepted : 29-5-2007

Excavation of the habitation area, Operation 3

To compare the 2005 research areas (Operation 1 on the western portion of the site and Operation 2 on top of the eastern rampart), we undertook excavations on the northern portion of the site designated as Operation 3. Operation 3 was located 50 m to the interior of the rampart wall and approximately halfway between the two northern gateways. The 2001-03 surface survey collection programme indicated that this northern area had a very dense and diverse set of materials. This area is also topographically the highest portion in the site and the only area where the interior deposits come up to the top of the inside of the rampart. Excavation in this area began with a small sounding 2 m in diameter; after encountering architectural remains at 57 cm below modern ground surface, the trial trench was expanded into an open excavation area measuring 13 m east-west and 18 m north-south.

Recording of excavated material was undertaken using a locus system (Harris Matrix) in which each arbitrary unit or integral stratigraphic unit (e.g. change of fill or feature) was given a number and recorded on a separate sheet. In areas of indistinct fill, a locus would be a maximum size of 5 x 5 m x 10 cm deep. A single continuous series of numbers was utilized to designate all trench components, such as fill, walls, pits, and other features. When there was differential fill (for example if the excavator noted the presence of greater amounts of bricks or pottery, or any soil colour change), then the locus would be terminated and a new locus number assigned to those materials as well as a new form. When a feature such as a wall was uncovered it would be given the next number in the series, and fill on either side of the wall each also would be given a separate number so that in the collected artefacts we would be able to distinguish those coming from the interior or exterior of the structure. Each excavator noted the relationship among loci through a diagram completed on each locus sheet and on a master sheet for the trench as a whole, updated on a daily basis.

Ceramics were collected per locus in gunny sacks; because there was a high concentration of ceramics, several gunny sacks were often required for each locus. Because of the very dense and compact nature of the fill in Operation 3, no regular sieving of deposits was done. Instead, artefacts including all visible ceramics were picked out by hand and separated by workers in the course of excavation. Bricks and tiles were not systematically collected but their size and percentage were noted for each locus. Non-ceramic artefacts such as slag, mica, and small finds were noted on the excavation form, and these finds were individually bagged in small plastic zip-type bags. The ceramic collection bags were weighed in the field with a hand-held spring scale and the total weight as well as number of bags noted on the locus form. This enabled a quick verification of the number of bags expected in the pottery sorting yard and also provided immediately-accessible data about the relative quantities of materials found in different areas of the trench. Tags were made using a rubber stamp and permanent ink on pieces of Tyvek, a plastic waterproof "paper."

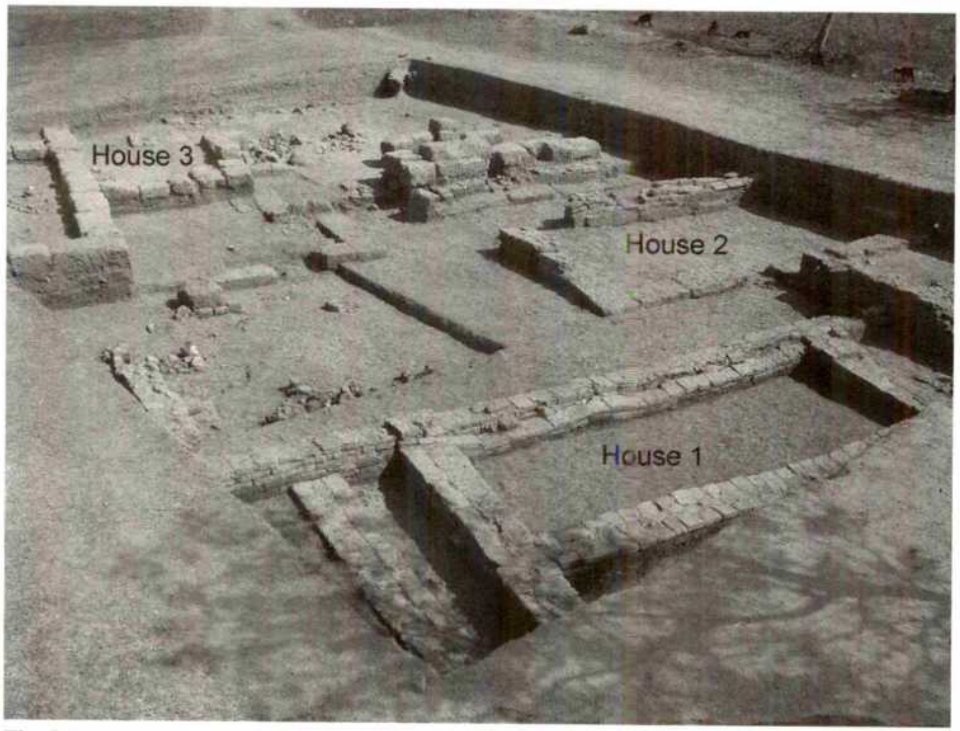

Fig. 2 General view of the excavation of habitation in the northern rampart area

The uppermost architectural elements of Operation 3, located in the top 60 cm of the exposed area, consisted of laterite block features and brick features that can be identified as three domestic structures (Fig. 2). In these upper deposits, nearly all of the bricks and tiles in architectural features were reused materials of irregular size, and very few complete bricks or tiles were recovered. Broken bricks were laid to produce a straight exterior edge and outline of the wall, and the area between bricks filled with broken brick fragments interspersed with mud mortar and some potsherds. The uppermost phase brick architecture was heavily damaged in some areas, suggesting that the architecture was exposed to the elements for a long period. In several cases the uppermost brick walls and laterite blocks had been cut with round holes measuring 20 to 25 cm in diameter in a manner that suggests either the presence of post-holes or the creation of a hole in the wall for placement of a receptacle. We did not recover any complete pots or other objects in the holes, but the bottom part of one of the niches cut through one of the laterite block walls had very dense green-yellow clay at the bottom that may have resulted from long-term trickling of water through the niche area.

The uppermost phase of architecture also included laterite block alignments, most of which were found in the northern portion of the trench. These blocks were of various sizes, ranging from 30 x 40 cm to 60 x 110 cm and rectilinear in shape. In some cases a layer of bricks was preserved on top of the laterite blocks, but for the most part the architecture consisted of only one course of bricks or stones. This suggests that the bricks and stones consisted of a foundation for an upper structure made of earthen materials, similar to the pisé structures found in nearby villages even today. The very high quantity of abraded ceramics in the 2-4 cm size range in the upper fill of Operation 3 can in part be explained by the reuse of domestic debris in the mud-making process. We conducted one test of this through the excavation of an area directly above a laterite block in trench Q, where we recovered a ceramic density of 121 kg/m^3, almost twice the highest ceramic density of any other location in Operation 3 and indicative of the selective use of ceramic-rich mud matrix by the ancient inhabitants. There were many other loci of fill in which the sherds were extremely worn and tumbled as though they had been deposited and redeposited many times. This was in contrast to the areas between structures in which there were larger sherds indicative of trash disposal.

The underlying architecture, which we labeled the upper-minus-one phase, was somewhat better constructed and better-preserved than the uppermost phase of architecture. The level of preservation suggests that structures below the uppermost architecture were either purposefully dismantled or at least not abandoned for a long period from one construction phase to the next. This upper-minus-one architecture was found preserved from around 60 cm to 1 m below modern ground surface and was made of bricks as well as some laterite blocks of varying sizes. At the end of the excavation season and in the southern portion of the trench, we also encountered a third phase of architecture in a very limited exposure, extending from around 90 cm to 1.2 m below modern ground surface. The terms upper, upper-minus-one and upper-minus-two indicate a relational sequence only and do not imply that all structures of a particular phase were in use simultaneously.

The layout of the structures suggests a number of independent buildings of domestic type. The brick structure in the southern portion of the trench appears to have undergone three phases of rebuilding: one at 57 cm below modern ground surface, one at 85 cm below modern ground surface, and one at 1 m below modern ground surface. The upper two sequences were made of broken bricks, although the bricks were well-aligned to present the unbroken faces along the line of the wall. The third phase, which was only exposed in a small area, constituted higher-quality architecture as it was made of whole bricks. Throughout the last two re-buildings, the structure retained the same basic plan of a long room divided into two portions, although the placement of the central dividing wall changed from one building episode to the next. In some parts of this structure, a single long wall remained as an anchor from one stage of rebuilding to the next, suggesting that there was a continual occupation and rebuilding rather than complete abandonment between architectural phases.

Structures with a foundation of laterite blocks were recovered in the northern and eastern portion of the trench. In the northwest corner, a structure made of large laterite blocks of varying sizes was partially exposed. Continued excavation in this area revealed a lower structure also made of laterite blocks, but constructed along a different plan and appearing to be made of regular laterite blocks with a formal "step" entrance similar to the architecture seen in Operation 1 and B.B. Lal's excavations on the western side of the site (see Lal 1949; Mohanty and Smith 2006).

As in the Operation 1 excavations of 2005 on the western side of the site, it was very difficult to discern the presence of floors in Operation 3: neither the sections nor the exposures within walls show any distinctions such as silt deposits, trampled sherds or layering of the type that might be expected with the use of either prepared floors or simple living surfaces. Throughout the whole area of Operation 3 we observed in the areas between structures the presence of numerous brick accumulations measuring 1 to 1.5 m in diameter and consisting of whole and broken bricks. These bricks were jumbled masses without any structural coherence, and perhaps represented stockpiles of construction materials. The brick accumulations, along with the presence of numerous large ceramic fragments between structures, indicated that the "empty" spaces between buildings were active zones for storage and discard.

Geophysical Survey

Because the 1948 and 2005 excavations at Sisupalgarh indicated that laterite block and brick architecture lie within 20-50 cm of the present ground surface, it was hypothesized that non-invasive techniques of investigation might be suitable for mapping the locations of subsurface architecture. This type of mapping would also let us put our excavated areas into a larger architectural context to show the potential extension of structures in the area beyond what is possible to excavate in the time available. In South Asia, geophysical research has been undertaken at other urban settlements such as Anuradhapura in Sri Lanka, in which a proton magnetometer was utilized to help identify the location of the moat around the fortification wall (Coningham 1994).

In addition to revealing the locations of structures and features, non-invasive geophysical techniques can also enable us to think in new ways about intermediate-scale spatial organization (Kvamme 2003). At large sites like Sisupalgarh, the use of subsurface investigation contains promise for evaluating theories of ancient urban organization. Traditional methods of archaeological research such as excavation can provide details about households, while large-scale surface survey and mapping can provide information about site size, spatial distributions of artefacts, and monumental architecture. However, there exists an "intermediate size" urban component that is of critical importance in understanding how households are integrated into neighbourhoods and how urban centres are subdivided and organized on the local scale. Our goal in the 2006 season was to use geophysics to address this neighbourhood level scale through the investigation of several different portions of the site.

Geophysical techniques work on the principle that buried archaeological features have different measurable physical properties than the soil that surrounds them (Clark 1996; Gaffney and Gater 2003). For example, a solid feature such as a wall would have different magnetic and electrical properties than a pit or empty fill. Although traces of these features may be invisible on the surface, their magnetic and electric properties can be recorded without excavation through the use of appropriate recording equipment. Geophysical investigations are not a substitute for excavation since the devices record only the presence of a magnetic or electrical anomaly and do not provide an unambiguous identification of the material itself. However, these methods are much more rapid than excavation and can place excavated areas into a larger context, such as the relationship among structures in a neighbourhood-sized portion of an ancient city.

Two geophysical techniques were employed at Sisupalgarh in 2006. The first was electrical resistance survey utilizing a Geoscan Research RM-15 Resistance Meter, a device with two pairs of metal probes that are inserted 5-10 cm into the ground at regular intervals along a survey transect (Donkin *et al.* 2006). A weak electrical current is passed between the two sets of probes and the resistance of the soil to the flow of electricity is registered in the device to detect subsurface changes. For example, electricity will pass differently through or around a "solid" feature such as a wall than through a pit due to the differing properties of the materials. Especially important in resistance survey is the moisture content of a feature. Data from the device is downloaded into a computer and used to make maps of subsurface anomalies.

The other method utilized was magnetic gradiometry, utilizing a Geoscan Research FM-36 Fluxgate Gradiometer. This method measures fluctuations in the earth's magnetic field caused by features immediately below the modern surface. As in the case of resistance survey, a brick or stone feature would register differently than a pit or empty space. This device is somewhat more difficult to use than the resistivity meter since the gradiometer, which weighs several kilos, must be carried exactly vertically in a manner that requires some practice and expertise. The device is carried along a straight line and automatically collects data at regular intervals to register the subtle magnetic differences under the surface. Data from the device is downloaded into a computer and used to make maps of subsurface anomalies. The maximum data capacity of the machine used for this project was 4 x 20 x 20 m units (25,600 data points collecting 160 data points per 20 m transect at 0.5m transect intervals), after which the instrument was brought back to camp for downloading of the data to a computer.

Five areas of the site were investigated through geophysics, for a total of 51,600 square m^2 of coverage (about 3.5% of the total site area; see Fig. 1). For each area, a grid was established with a north-south angle set according to magnetic north. For both methods, it was planned that 20 x 20 m would be the standard recording unit, although the density of data collection could be variable (for example, the probes on the resistivity device could be either 0.5 or 1 m apart, and the gradiometry transects could be at 0.25, 0.5 or 1 m apart). In the initial days of the work, the geophysics team experimented with these variable settings to determine the most efficient coverage methods that would yield distinct data. Choices about areas to survey and their boundaries were affected by a number of factors, the most significant of which was the avoidance of any areas containing metal (such as utility poles) because this would interfere with the recording device.

Both techniques were affected by the specific conditions at Sisupalgarh. Electrical resistivity proved to be a somewhat slow technique because the dryness and compactness of the soil made it difficult for the probes to be stuck into the ground. Gradiometry and resistivity were both inconclusive in small areas (i.e. less than one hectare in size), because of the very high density of pottery and brick fragments in the topsoil. At this site, potsherds and brick fragments (being made of clay and therefore generating their own magnetic presence) appear to obscure the signals coming from underlying architecture. Trial investigations with both methods in the area of Operation 3, for example, did not discern the outlines of the walls that we subsequently revealed through excavation. Larger areas and more substantial features thus proved to be a more appropriate scale for providing a picture of subsurface remains. Initial trials of the equipment adjacent to the area of the 1948 excavations, where the 1948 excavations had encountered a fragment of a road (Lal 1949), confirmed that geophysical methods under these site conditions could detect large subsurface anomalies.

The geophysical survey enabled us to test an important hypothesis about urban organization at Sisupalgarh. While there are many fortified urban sites of the Early Historic period, Sisupalgarh is the most regularly-planned of these centres, with matching gateways along each of the four walls. As B.B. Lal himself (1991:18-19) observed on the basis of his previous excavations, a road could also be expected on the basis of the regular outline of the rampart gateways as well as normative expectations preserved in the *Arthasastra*, an Early Historic text on kingship and governance. The geophysics team went to the southwestern quadrant because this was an area in which large numbers of contiguous fallow rice fields could be traversed with the equipment. It was also an area where, if roads could be discerned, might hold a crossroad from the northern and southern gateways.

The 2006 gradiometry results included a very distinct linear feature extending from the southwestern gateway inwards towards the east (Fig. 3). At approximately 360 m inwards, this east-west feature intersects with a linear north-south feature. The alignment of the linear features with the angles of the rampart wall and the location of the gateways suggest that what lies under the surface is a road feature coming in from the two gateways. Further, the linear feature appears to have additional lines bisecting them at right angles, in a manner suggestive of smaller crossroads. Although ground-truth checking through excavation would be necessary to confirm these observations, the geophysics have demonstrably produced results about the settlement configuration that are much more extensive than could be achieved by excavation alone.

Deep Sounding in the Northern Portion of the Site (Core Sequence 3)

To complement the deep sounding of 2005 on the western portion of the site, we placed this year's deep sounding in the northern portion of the site 40 m south of the Operation 3 excavations. Because of the very dense and clayey cultural deposits within the rampart walls, the interior of the site has a water table that is higher than the area on the outside of the rampart. It was anticipated that the higher elevation in the north would enable us to excavate more deposits prior to encountering this interior water table. In the 2005 season we had excavated a deep sounding to

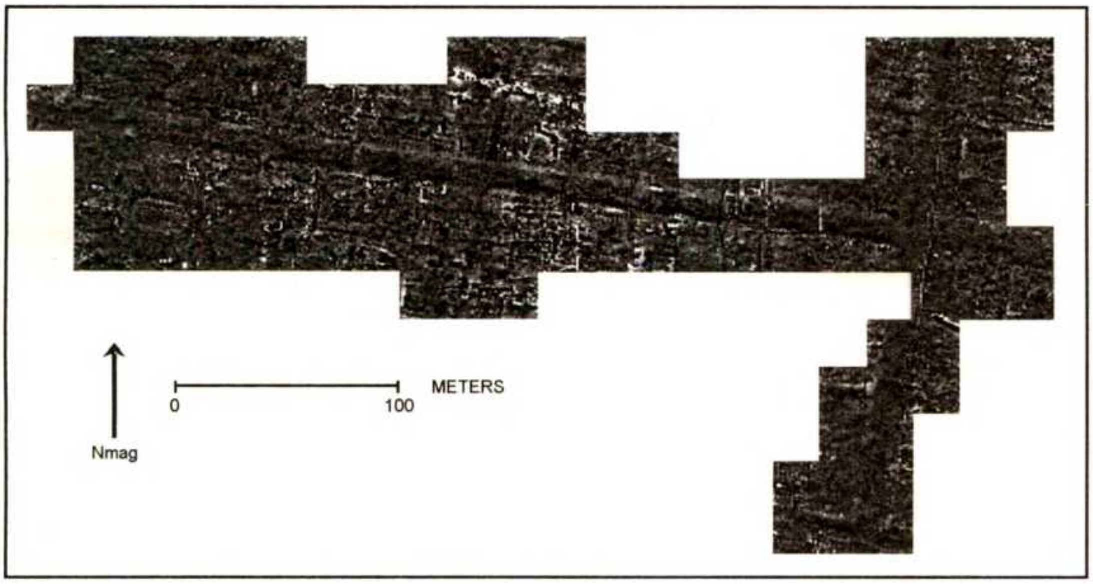

Fig. 3 Geophysical survey showing alignment coming from two southwestern gateways

natural soil on the western side of the site approximately 100 m east of Lal's excavated gateway. In that sounding, the water table was only 2.1 m below the present ground surface but cultural deposits continued downwards to a total depth of 5.6 m at which point the sounding terminated onto natural soil consisting of a very sticky natural gray clay. The 2006 deep sounding was laid out as a round 2 m diameter trench, at the suggestion of the workers who advised a circular trench to have a better stability of the trench wall while excavating the deep sounding. The trench was excavated in 30 cm arbitrary units which were called "splits," numbered consecutively from 1 (topsoil) to 22 (bottom of the trench). Within each 30 cm unit, a sample was removed for flotation, carried out at a separate location using clean well water.

At 2.6 m below modern ground surface, water began seeping into the trench; we then utilized a pump to remove water so that excavation could continue. From this point downwards all deposits from the trench were water-screened with mesh stretched out over large sieving beds. At 6.7 m below modern ground surface, we encountered a dense, sticky gray clay that no longer contained any artefacts. The colour and texture of the clay was the same as what we had encountered at the bottom of the 2005 deep sounding. To be absolutely certain that this material was natural soil (rather than, for example, a flood deposit) we utilized a soil auger to dig a sample with a radius of 10 cm for another 1.1 m. The entire depth of this additional 1.1 m sounding was also sticky gray clay, indicating that there were no further cultural layers and that we had reached natural soil in this location.

The upper two metres of soil in the core sequence had relatively few artefacts, a considerable contrast to the very dense amount of ceramics in the upper topsoil in the area of Operation 3 which was located only 40 m to the north. There was no discernable surface topography that might explain this difference, since all of the area in the northern portion of the site is of more or less uniform height. The relative absence of ceramics, bricks and other artefacts throughout the upper two metres of deposits suggests that the area of Core Sequence 3 may have been an open portion of the neighbourhood in the last phases of the occupation, such as open public space, animal pens, drainage area, or kitchen garden. Starting in split 8 (2.22 m below modern ground surface) and continuing until the bottom, the trench contained a very high density of architectural elements and ceramics.

Core Sequence 3 included at least five phases of architectural remains. As the goal of the core sequence was to conduct a deep sounding rather than a horizontal exposure, it was not possible to assess the layout or function of the architecture except in very general terms. The sequences of architecture visible in this deep sounding can be summarized, from the top down, as follows:

1. A feature with three courses of bricks 1.35 m below modern ground level that was visible in the section only and that did not continue into the trench. The function of this feature is unknown but it may have been a structural foundation similar to brick alignments seen in Operation 3.
2. A feature of seven bricks in a single course at 2.0 m below modern ground level. This feature did not continue into the trench wall but was completely contained within the area of the 2 m diameter trench. Its function is unknown, but removal of the feature revealed a compact layer of material with a large amount of laterite fragments that may have served as a floor or other prepared feature.
3. A feature of large upended laterite blocks forming a corner within the unit, first appearing at 2.85 m below modern ground surface. The north-south laterite block measured 124 x 51 x 19 cm in size. The east-west alignment consisted of two laterite blocks (one entire block measuring 126 x 29 x 16 cm and one fragment that continued into the trench wall but whose extant portion was 37 x 47 x 15 cm in size).
4. A feature consisting of 12 courses of bricks, running E-W and embedded in the north trench wall, with the uppermost course appearing at 3.30 m below modern ground surface. This brick alignment either was built on uneven ground or suffered subsidence after its construction, as the feature dips down from the west to the east a total of 15 cm over a two-metre length.
5. A feature consisting of laterite blocks turned upwards on their sides, parallel to the same level as the brick feature 4 and with 57 cm of earth fill between the bricks and the laterite blocks. The area between the bricks and the laterite blocks was excavated separately (split 13A) from the area to the south of the laterite blocks and in the rest of the trench (split 13). Split 13 included a layer of material that appeared highly organic and very distinct from the dense, sticky deposits that we had previously encountered in the core sequence. The quantity of botanical remains also decreased markedly in this split. In addition, the workers reported that the organic material smelled like cow dung. However, the presence of two beads (one clear crystal and one badly-faceted carnelian bead) along with a high density of potsherds indicates that this was not likely to have been simply a dump for animal by-products.

Architectural sequences 1, 2, 3 and 4 in this deep sounding appear to be unrelated and not part of the same structure as there was always at least 5-10 cm of soil between the construction elements. Architectural features 4 and 5 were probably in use at the same time as part of the same

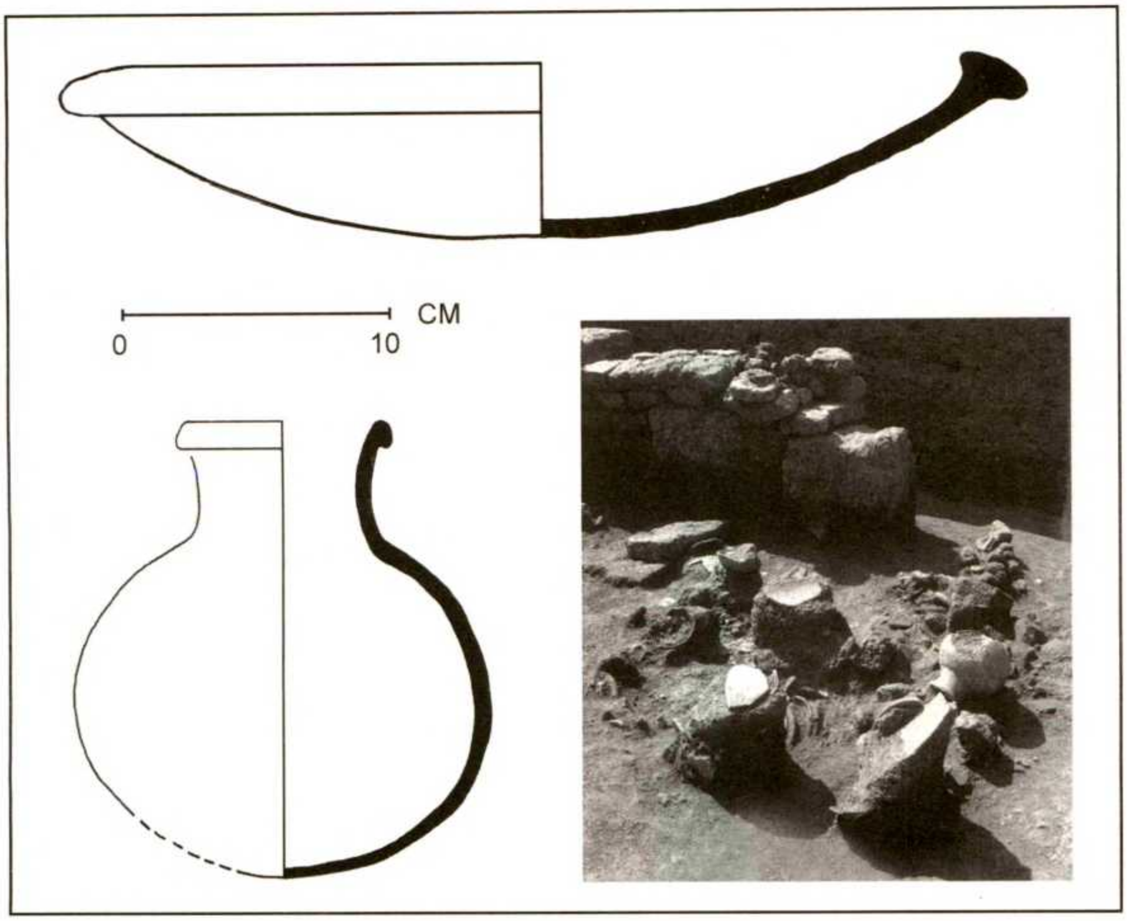

Fig. 4 Ceramics from excavation and areas of discard between houses in the habitation area

structure, but again our restricted work area meant that it was not possible to discern the plan of the construction or its purpose.

The 2006 deep sounding on the northern side of the site produced the same sequence of artefact and architectural changes as was observed in the 2005 deep sounding on the western side of the site. The ceramics at the bottom of the sequence are characterized by high-fired wares, often with a glossy red or black slip. Decorative types at the bottom of the sequence include flat-bottomed bowls with a small bump on the interior centre ("knobbed" wares). Graffiti consisting of simple geometrics is found on high-fired wares, and includes both pre- and post-firing incisions. At about the mid-point of the excavation sequence, high-fired wares cease and are replaced by lower-fired wares that include a new dominant shape in the form of a plain bowl with a string-cut base. Fine wares also cease except for the appearance of flat-bottomed bowls with a series of small indentations in a circle around the interior centre ("rouletted" wares). New architectural forms appear at this stratigraphic midpoint, as seen by the first appearance of tiles that become a very common occurrence by the uppermost occupational phases.

The appearance of the same cultural pattern in two different areas of the site indicate that changes in the manufacture and use of ceramics and other objects may represent a site-wide economic shift. This shift should not, however, be interpreted as a simple "impoverishment" of the material record. The appearance of roof tiles as an architectural feature suggests relatively robust structures capable of supporting a heavy roof (each tile weighs approximately 1kg, considerably more than an equivalent amount of other roofing material such as thatch or bamboo). The large quantity of tiles also indicates the capacity of the site's inhabitants to finance the manufacture and transport of these heavy and fragile construction materials. The appearance of expedient pottery production and high rates of discard (as indicated by the presence of many string-cut bowls), indicates that significant changes also occurred in other types of manufacturing. The appearance of new forms may reflect new strategies of food preparation and/or consumption, perhaps related to an urban economy in which a market or market-like system replaced direct acquisition of food. Limited reconnaissance in the area outside the rampart walls indicates that the site's final occupation phases extended well beyond the urban core, meaning that it was relatively unlikely that people living within the rampart would all have been able to engage in farming as there would not have been sufficient land close to the urban centre.

Ceramics

The principal aims of the ceramic sorting were to record the shapes of vessels and types of decorations which would enable us to identify domestic consumption patterns and economic activities related to the production and distribution of ceramics vessels for cooking, storage and eating (Fig. 4). Because of the very large quantities of pottery recovered in these domestic excavations at Operation 3, body sherds were weighed as a group and no further distinctions were made except to note the presence of wares of a homogenous silty fabric (these were usually no more than one or two body sherds per locus and often did not appear at all). These very silty wares, usually quite abraded with no decoration, appear from previous experience with the Sisupalgarh materials to be heavily worn sherds of Rouletted Ware. Well-preserved fragments of Rouletted Ware did not appear in the deposits of Operation 3; although evidence is limited, it can be interpreted that this uppermost phase of occupation postdated the use of Rouletted Ware at the site.

Observations of the body sherds from Operation 3 showed that ware types were exactly the same as the materials recovered from Operation 1 and from the upper levels of the deep soundings: oxidized (red) wares, predominantly unslipped, with fine, medium and coarse sand inclusions. Diagnostic sherds (rims, bases, handles) were divided into seven basic categories: small jar, medium jar, large jar, plain rim bowl, bowl with thickened rim, rim with handle, and base (of plain rim bowl). Rims that were not otherwise represented by these basic categories were drawn to scale to enable future comparisons. Pottery decorations included appliqué, incision, paddling and grooves. Although the range of decorations was similar to those seen in Operation 1 and in the surface survey materials, the uppermost levels of Operation 3 decorations did tend to have more exuberant and rapidly-executed versions of appliqué in which a number of different styles were combined. Some types of decoration, such as stamped appliqué wares, also appear in a higher proportion in Operation 3, again suggesting that this northern area of the site had perhaps one more (later) occupational phase than elsewhere in the site.

In Operation 3, we perceived the occasional presence of materials that appear to "belong" to an earlier chronological period, such as the tiny-punctate paddle-and-anvil design seen in abundance only in the lower levels of the deep soundings. However, the amount of "recycled" lower material appears to be less than elsewhere in the site; while in Operation 1 we estimated that such "recycled" ceramics comprised 1-2% of the habitation deposit, for Operation 3 the lower sherds appear to have occurred in a frequency much lower than 1%, and many loci from Operation 3 had no apparent lower material at all. These observations suggest that inhabitants of Operation 3 (at least in the portion excavated) practised the recycling of materials from nearby deposits instead of excavating deep into the underlying strata. Although the area of Operation 3 is too small to say with certainty that there were no ancient wells or other deep diggings there, it is possible that the residents of the Operation 3 area were close enough to the rampart that they were obtaining water from the exterior moat rather than from wells within the site itself.

The very high densities of ceramics in Operation 3 were similar to the cultural layers of dense pottery recovered in the 2005 excavations on the western portion of the site. The highest densities of Operation 3 were noted in square F, where the upper deposits yielded loci with pottery densities as high as 75 kg/m³ (a figure that can be compared with Operation 1 densities in uppermost fill that was also as high as 75 kg/m³). The large volume of pottery in the areas between structures in Operation 3, most of which was rapidly made and consisting of small bowls, indicated that at least some vessels were virtually of the 'use and throw' variety.

Other Materials

The majority of antiquities from Operation 3 consisted of terracotta ornaments in various forms: beads, bangles, pendants, rings and earspools. Small finds in Operation 3 also included one metal-foil glass bead, several stone bead fragments, and a small number of iron artefacts such as nails. The total weight of iron artefacts in all of Operation 3 was 439 g. Although this is a small amount, the apparent lack of iron ore in the geographical vicinity of Sisupalgarh indicates that such goods were being traded from some distance. In comparison to Operation 1 in 2005, we found very few fragments of the small ceramic vessels identified as "crucibles." Grinding implements were a distinctive component of the Operation 3 habitations and several sandstone pounders were recovered. One distinct artefact was a legged quern whose legs were unfinished although the surface of the quern showed use as a grinding imple-

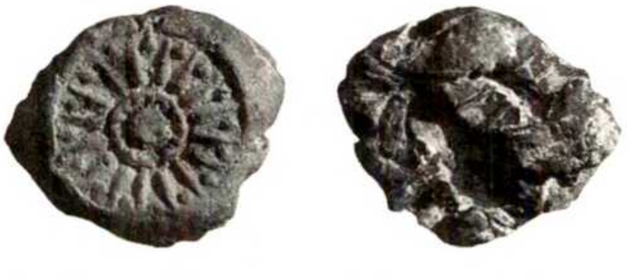

Fig. 5 Terracotta sealing from deep sounding (Split 9, 2.5-2.8 m below modern ground surface; sealing measures 4 cm in size)

ment. The deep sounding produced additional evidence of trade activity in the form of a small number of stone beads and a terracotta sealing (Fig. 5).

Conclusions

The 2006 geophysics and excavation results at Sisupalgarh provide the following provisional conclusions:

1) Excavation of a habitation area on the northern portion of the site (Operation 3) has revealed architectural components, ceramics, and other finds that are similar to the excavations on the western portion of the site and similar to the surface materials collected throughout the site in the 2001-03 survey sessions. These observations further confirm that the site was fully occupied through the last phase of occupation, with the suggestion that the northern area may have been the last portion of the site to has been abandoned. Further research in the area of Operation 3 would allow us to expose at least one of the structures fully to achieve a better understanding of household organization and architectural sequences at the end of the site's life.
2) The deep soundings (Core Sequence 1 of 2005 and Core Sequence 3 of 2006) show that there was a significant qualitative and quantitative change in pottery styles and technology in the course of the site's occupation. Pottery at the bottom of the sequence, representing the earliest occupational phases, is labour intensive and high-fired with glossy slip, while pottery at the latest occupational phases is low-fired and unslipped. Architectural changes are also seen, including the development of tiles as a common building component in the latter half of the site's occupation. These distinctions, being found now in two different areas of the site, enable us to make some generalizations about economic patterns at the site and the appearance of a significant cultural or economic shift while the city was inhabited. Although the causes of this shift are not yet known, they may be due to changes in trade patterns, social organization or political hierarchy at the site or in the region.
3) Geophysical survey at the site through the use of electrical resistivity and magnetic gradiometry revealed subsurface architectural arrangements, most notably the presence of what appears to be a long "road" entering into the site from one of the southwestern gateways. The presence of this feature within 1 m of the present ground surface indicates that a rectilinear grid of streets and rampart features was maintained, at least in this portion of the site, until the last occupational phases. Continued geophysical work may allow us to evaluate the presence of a site grid throughout a larger portion of the site away from the rampart walls.

Acknowledgements

We would like to thank the Archaeological Survey of India for permission to work at Sisupalgarh, and for the logistical support provided by the Bhubaneswar Circle during the course of the research programme. Many thanks also go to Prof. B.B. Lal for his kind willingness to answer questions about the earlier excavations. We would also like to express our sincere thanks to Dr. P.R. Mehendiratta and the American Institute of Indian Studies for their support of the project. Much appreciation goes to the members of the research team: Dr. M.D. Kajale and Dr. S. Mishra; Y. Behera, P. Behera, E. Brite, M.K. Das, B. Gandhi 'Deori', A. Donkin, S. Garada, A. Lawate, S. Mohapatra, S.K. Mallik, A. Pataskar, K. Pawar, Sk. Saleem, B.B. Satapathy, S. Sahoo, J. Sutter, T. Thakuria, and A. Walling; and to local workers A.K. Dash and L. Reddy. Our appreciation goes to D.N. Bhoi and N.K. Swain for their attentive participation as representatives of the Archaeological Survey of India, Bhubaneswar Circle. We would like to collectively thank the local residents of Sisupalgarh for their cooperation. Funding for this project has been provided by the National Science Foundation (Grant No. 0550035); the Ahmanson Foundation; and the Academic Senate, the Department of Anthropology and the Cotsen Institute of Archaeology, University of California, Los Angeles.

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Evidence of a Stupa at Sisupalgarh, Orissa: Re-interpreting Earlier Excavation Data

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Abstract

The Early Historic site of Sisupalgarh in Orissa has been under investigation by various scholars since 1948. However, it is not known by many that Sisupalgarh was excavated in 1950 by B.K. Thapar. During this excavation B.K. Thapar claimed to have excavated two megaliths near Sisupalgarh that remained unreported till date. The examination of the archival records pertaining to 1950 excavations in the light of recent archaeological findings has established that one of the structures that was excavated as a megalithic circle was actually a stupa structure.

Introduction

Orissa is known for Buddhist art and architecture from the 3rd century B.C. onwards which are coeval with the conquering of Kalinga by the Mauryan emperor Asoka. There is evidence of Buddhist remains belonging to an early period including Asokan relics mostly found in the Dhauli-Bhubaneswar region, where the ancient city of Tosali was located. These include stupa railings and fragments of Asokan pillars. (Patnaik and Acharya 2000). No stupa from this area has yet been reported.

During this post-Mauryan period, regional Buddhist centres started developing, such as Bharhut, Bodhgaya, Sanchi, Amaravati, etc. with extensive structural activity of Buddhist architecture and art in the form of stupas,

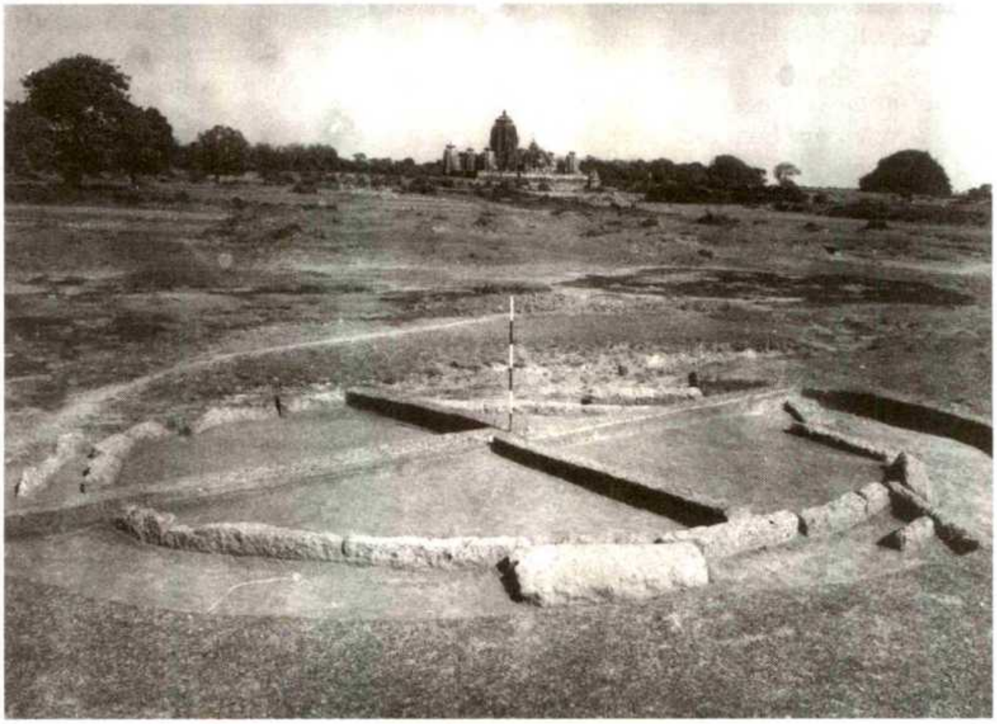

Fig. 1 Sisupalgarh: Megalithic circle as excavated by B.K. Thapar in 1950. In the background Brahmeswara temple can be seen (view from southwest)

Received : 29-3-2007
Accepted : 20-5-2007

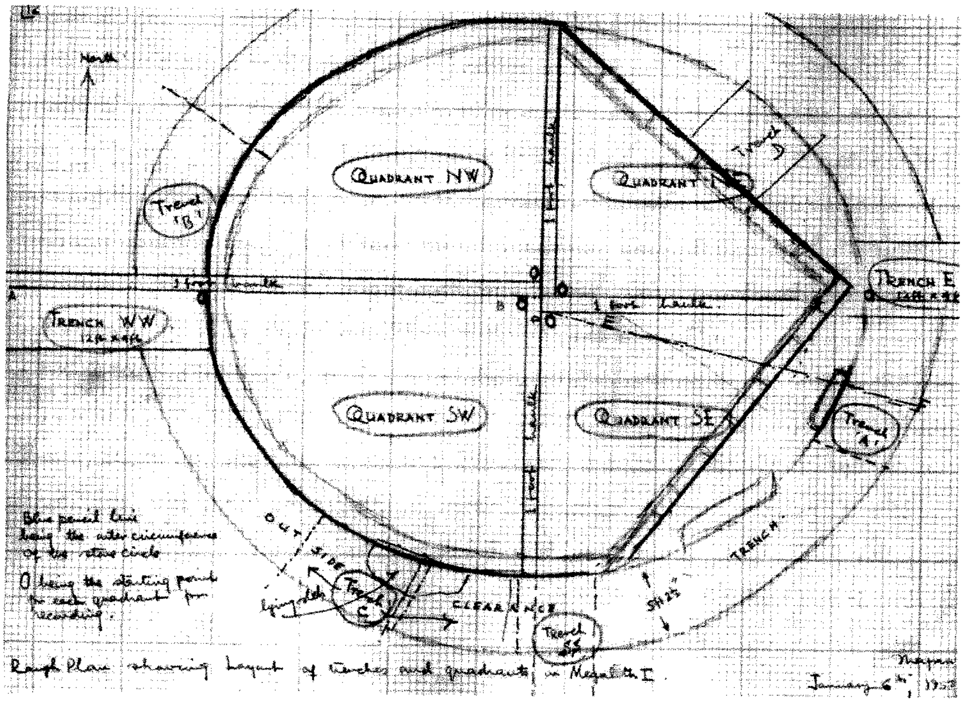
North
Quadrant NW
Quadrant NE
Quadrant SW
Quadrant SE
Trench 'B'
Trench WW 12ft × 4ft
Trench E
Trench 'D'
Trench 'A'
Trench C
Trench SS
Trench
A
B
O
Out side
Clearance
5ft 2½"
Blue pencil line being the outer circumference of the stone circle
O being the starting point for each quadrant for recording.
Rough Plan showing layout of trenches and quadrants in Megalith I
Thapar
January 6th, 1950

Fig. 2 Sisupalgarh: Rough plan showing layout of trenches and quadrants in Megalith-I (Megalithic circle) as drawn by B.K. Thapar

chaityas, cave architecture, etc. Sahu (1958:32) wrote, "In this chain may be included the great Stupa of Bhuvanesvara, that was constructed during this period, but has vanished at present like those of Amaravati and Jaggayyapeta, leaving behind only a few traces of its glory. Unfortunately, this stupa has failed to draw the due attention of scholars .... except few remains of it". So far a number of stupa railings were reported from Bhubaneswara area from 1926 when such a railing was first discovered. A vivid description of such early reports is given by Sahu (1958: 32-34) in his monumental work on Buddhism in Orissa.

The Chinese traveller Yuan Chwang who visited the place in the first half of the 7th century A.D. describes the presence of the Asokan stupa to the south of the capital of Kalinga. "The site of the stupa near Tosali, the then capital of Kalinga has been traced somewhere between the Dhauli rock and the temple town of Bhubneswar, and some scholars are of the opinion that the huge mound lying on the western bank of the rivulet *Gangua*, to the right hand side of the road leading from Bhubanesvara to Saradeipur preserves remains of it. There are, however, a number of such ancient mounds on the outskirts of Bhubanesvara, and it is difficult to say without a systematic excavation as to which of them retains of the *Asokan* Stupa" (Sahu 1958: 26-27). Unfortunately, this remained enigmatic till date due to lack of any substantial evidence.

However, it is clear that on the basis of sculptural representations on various railings, these belong to more than one stupa. Since all these railings are from Bhubaneswar, it may be presumed that more than one stupa existed in and around Bhubaneswar.

Excavations at Sisupalgarh

Excavations at Sisupalgarh are being undertaken by Mohanty and Smith (2006: 27-32). The site of Sisupalgarh, an Early Historic settlement on the south-eastern edge of Bhubaneswar was first excavated by B.B. Lal in 1948, published in 1949 (Lal 1949: 62-105). The excavation continued in 1949. Unfortunately except for a brief note; a detailed report of the work carried out in 1949 was not published (Lal 1990, 1991). Most of us do not know that the excavations at Sisupalgarh continued to the third season in 1950 in a limited manner. The excavation during this season was undertaken by B.K. Thapar, then a Superintendent of the Excavation Branch. No report in any form has yet been published. In fact, I learnt for the first time about this excavation in 2005 while looking into the archival records of the Sisupalgarh excavation.

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* The old scale of measurement in feet and inches has been retained while quoting from the field notes of the excavator.

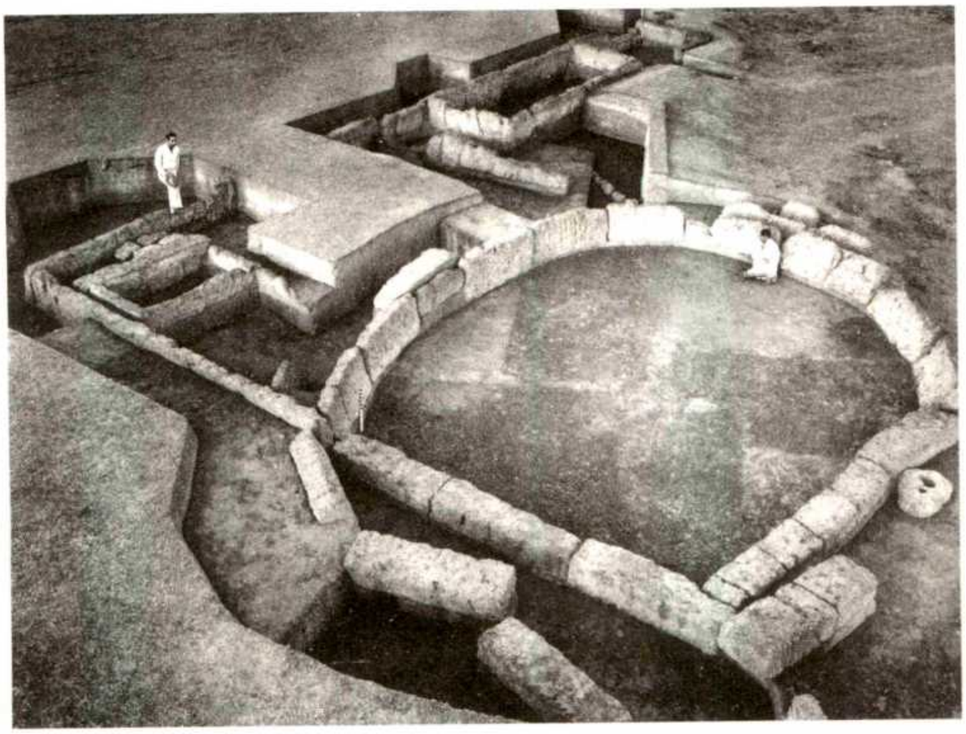

Fig. 3 Sisupalgarh: General view of the megalithic circle after excavation by B.K. Thapar in 1950 (view from east).

Evidence from the 1950 Excavation

Of all early excavations, the work done in 1950 by B.K. Thapar is of interest to us in understanding Buddhist archaeology of Bhubaneswar. Thapar claimed to have excavated two megaliths. Of these, the stone circle, i.e. Megalith-I (as termed by Thapar) is what is discussed in the present paper. The excavator describes Megalith-I (Fig. 1) in his field notes as follows* :

"Midway between the Sisupalgarh fort and the Brahmeswara temple along the northern banks of the streamlet (Gangua) lies a mound with a relative height of 4-5 feet from the surrounding low ground".

"The 'run off' water was at certain places revealed structures which on plan and from their appendages appear to be 'megalithic'. They include stone circles and also rectangular chambers, though not exactly resembling the well-known cists".

"The diameter of the stone circle, on the other hand varies from 26 ft. to 38 ft. The sub-soil here is laterite rock. The monuments, therefore, are built of laterite blocks nicely dressed to take the shape of circle stones. The broken ground nearby also shows places of quarry from where the stones possibly may have been obtained. The ground level since the building of these structures has risen to an extend that of some stones only the top is visible while others are buried 9 to 10 inches below the ground."

"The circle is not an exact circle but resembles an oval, with bigger diameter of nearby 33 feet on the east-west line and the smaller diameter of nearby 28 feet on the north-south line" (Fig. 2).

From the excavated photograph of the stone circle (Fig. 3), it is clear that the eastern half of the circle is disturbed, as also started by the excavator. As a result, the upright laterite blocks at the periphery of the circle on the eastern side are disturbed and displaced out of the circular alignment. Because of this, Thapar possibly wrongly calculated the east-west diameter to be 10 m. Since the western half is intact, constituting the undisturbed arc of the circle, the diameter of the circle may be calculated to be 8.50 m.

Laterite blocks were erected vertically along the perimeter of the circle in such a manner that it appears to have been erected to support the earth-filling in the middle. Interestingly, the excavation has the evidence of another circle around the inner circle with a gap of about 75 cm. This feature is described by the excavator who states, "In the north-western quadrant again there is some evidence of a second circle, wherein two stones were found lying in an arc closely following the main circle". If this observation is accepted, then the outer circle was perhaps constructed to support and strengthen the inner circle. The space between the circles might have been filled with earth. Perhaps it is essential to know the stratigraphy of this structure. As described by the excavator the eastern half of this circular

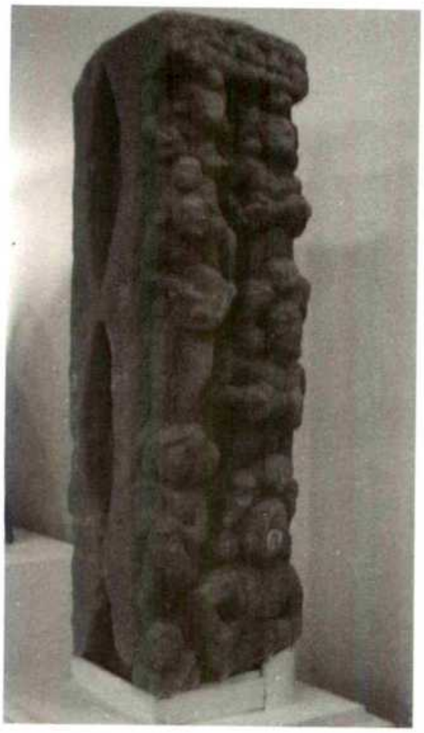

Fig. 4 Orissa State Museum: Stupa railing from Badagad

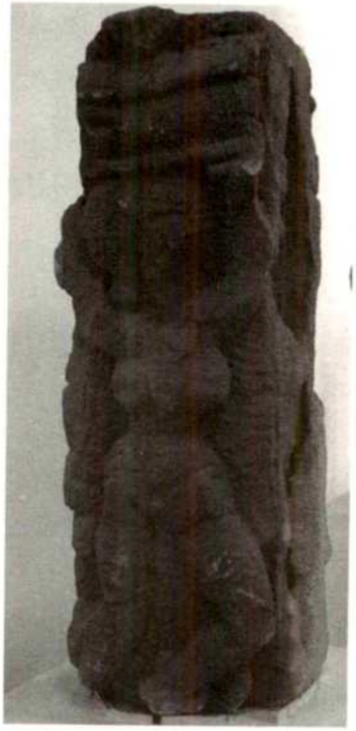

Fig. 6 Orissa State Museum : Stupa railing from Badagad

structure is disturbed due to later interventions of structural activity that occur in the form of lateritic blocks arranged in a straight line forming an angle on the eastern side. Thapar writes; "After clearance of the boundary stones it was discovered that these stones were part of another structure. They also form an angle with another stone placed at the eastern end. Further, these stones are not in an arc but are all in a straight line.... At the present state of our knowledge it is difficult to judge their plan and also their relationships to the main monument, *viz.* the stone circle." A few days later when the excavation progressed, he stated "Further the relationship of the angle wall was also established. It is a single course structure of dressed laterite blocks of average thickness of 1 foot (30.5 cm.). This is built in layer (3), viz. layer (3) has been cut into and even the layer (2) of laterite gravel seems to have been disturbed. It follows, therefore, that this is a later structure. Furthermore the circle stones also on this side are missing."

Since the eastern half of the circle is disturbed, let us understand the stratigraphy of it as noticed on the western half which is better preserved. Thapar has beautifully drawn the stratigraphy of the western half himself in his notebook, where the deposit inside and outside the circle can be seen.

On the western half, inside the stone circle underlying the humus deposit, i.e. layer (1) is layer (2) which is composed of red gravel. This deposit becomes more compact and darker towards the base, and did not yield much pottery. Layer (2) has an average thickness of 25 to 27.5 cm. Layer (3) is composed of hard sticky grey clay and occurs in clods with an average thickness of 17.5 to 20 cm. This deposit also bears stray sherds. Below, this is layer (3A). The composition of layer (3A) is the same as that of layer (3), and differs only in that it has a yellowish colour. At places this is separated from the overlying deposit by a yellow streak (2 m long on the main east-west section). Layer (3A) was excavated to a depth of only 15 to 17.5 cm.

In contrast, the outside deposit has humus, i.e. layer (1) that underlies essentially a debris layer, i.e. layer (2), and contains besides many pottery pieces, tiles and brick fragments. Layer (2) has an average thickness of 0.45 m. At about 0.61 m below the surface this layer changes its character. The composition becomes slightly ashy at places but retains its main character of being a debris layer and is termed as (2A). The nature of these sediments, i.e. layer (2) and (2A) outside the circle clearly suggest that they are later deposits. The stratigraphy indicates that layers (2) and (3) inside the circle are deliberate packing, as described by the excavator.

The layers (3B) and (3C) noticed inside the circle pass beneath the circle stone and are, therefore, earlier than the structure. These deposits also continue on the outside of the circle as layers (3) and (3A), respectively. Interestingly layer (3B) inside the circle is described by the excavator as being a small debris layer. This suggests the existence of

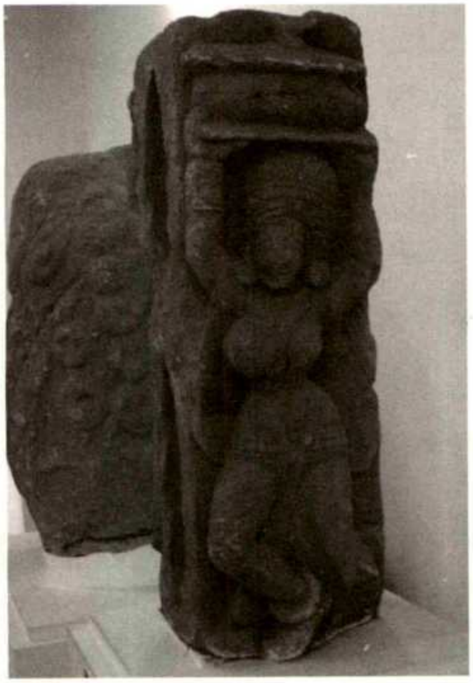

Fig. 5 Orissa State Museum: Stupa railing from Badagad

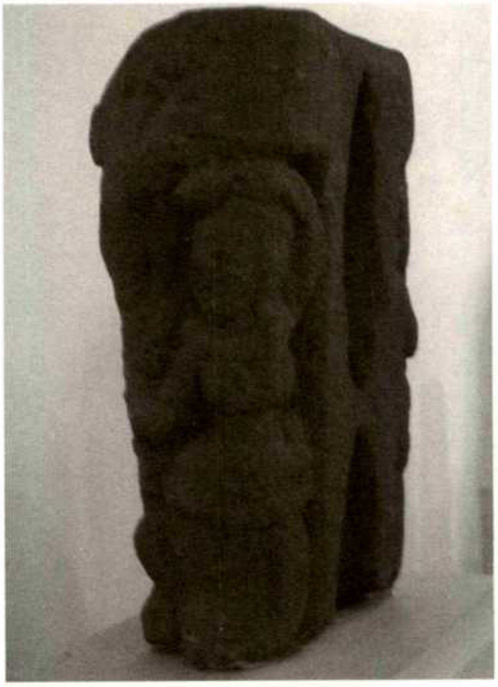

Fig. 7 Orissa State Museum: Stupa railing from Bhubaneswar

some human occupation prior to the construction of this circular stone structure at this place. Further, the excavation both inside and outside, continued up to layer (6) which has also yielded potsherds and represents a pre-circular stone structural activity.

When B.K. Thapar carried out the excavations at Sisupalgarh in 1950 he was 28 years old. This was one of his early independent excavations. Before this, he had participated in excavations at Brahmagiri carried out by M. Wheeler in 1947. There, Thapar was exposed for the first time to excavations of Megaliths. At Brahmagiri, for the first time attempt was made to understand the nature of the Megalithic culture. Black-and-Red ware was first identified here as being the characteristic ceramic of the Megalithic tradition.

With this background and experience, when Thapar initiated excavations at Sisupalgarh, he associated Black-and-Red pottery with the Megalithic tradition and tried to look for Megalithic burial sites. With this pre-conceived notion, Thapar identified them as the Megalithic burials.

Reinterpretation of the 1950 Evidence

As discussed earlier Bhubaneswar and its surroundings provide evidence to suggest the existence of stupas in this area. One such evidence is the presence of several stupa railings collected from the areas around Bhubaneswar, now exhibited in Orissa State Museum (Figs. 4-8). Their relationship with stupa remains was not established.

In January 2006 when excavations at Sisupalgarh were in progress, a joint exploration was carried out by the present author and R.K. Mohanty of Deccan College. Surprisingly a stupa railing was located near a temple (Fig. 9) in a hamlet on the northern side of the Sisupalgarh fortification. This piece was under worship just outside the shrine. Because of its rarity, it was lodged in the Bhubaneswar Circle of Archaeological Survey of India. This area is, in fact, located on an isolated mound north of northern fortification of Sisupalgarh. From this elevated area, the Brahmeswara temple is visible at a distance, though not as clearly as compared to photographs of 1950, owing to an increase in habitation in the area in recent years. However, based on the archival photo records, it is clear that this is the same raised land where B.K. Thapar excavated the megalithic circle.

The piece of railing and the location of the excavated megalithic circle in the close vicinity, prompt us to rethink Thapar's report. The present discovery of a railing piece is noteworthy. This has sculptures in high-relief on both sides (Figs. 10-12). Stylistically it can be ascribed to Sunga-Kushana period. This suggests that during this period, a stupa was present here. Let us re-analyze the evidence of Megalith-I, a stone circle, in the light of this discovery.

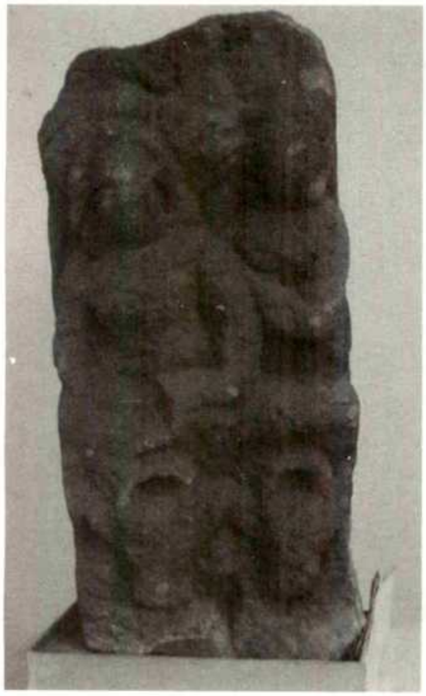

Fig. 8 Orissa State Museum: Stupa railing from Bhubaneswar

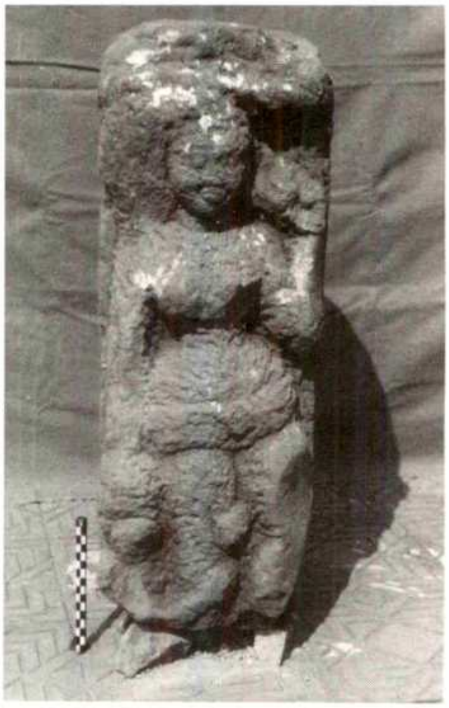

Fig. 10 Sisupalgarh: Side view of Stupa railing (26th January, 2006)

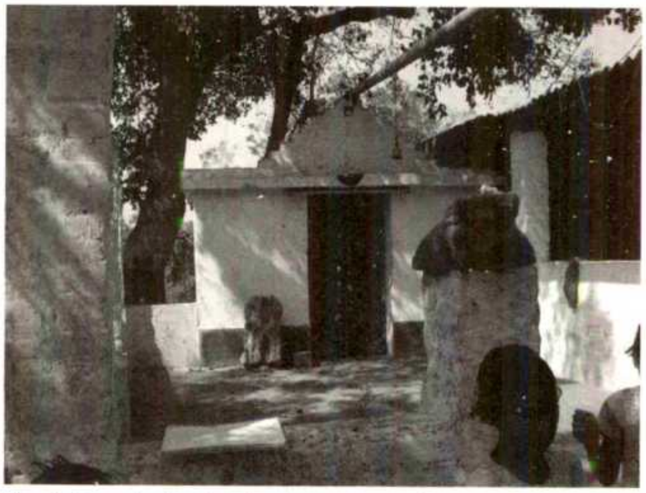

Fig. 9 Sisupalgarh: Temple where stupa railing was found on 26th January, 2006

There has been no report of megalithic structures of any type till date, either from Bhubaneswar or from its surroundings. This poses some doubt about the megalithic circle that was excavated by Thapar. Secondly, it is surprising that Thapar has never referred to this rare evidence anywhere in his publications.

Black-and-Red pottery and the occurrence of an unusual circular structure prompted Thapar to ascribe the discoveries as being Megalithic. However, when he understood the nature of the Indian megalithic tradition doubts may have set in. This statement is clear from his field notes: "Now, at the time of excavations no 'megaliths' were known to exist near about the Sisupalgarh fort and the presence of the black-and-red ware without megalithic monuments was presenting a problem. Hitherto this ware has been commonly understood to be a burial pottery, connected with the megalithic monuments only. Although not many excavations have been conducted to prove it otherwise, ..."

Now coming to the evidence of structure proper, it is a circle of dressed lateritic blocks aligned vertically in two rows with a diameter of approximately 28 feet (9.80 m), to support the filling material inside. The structural filling material is devoid of any cultural remains as described earlier. Even the excavator states that layers (2), (3) and (3A) inside the circle – "... do not continue outside, meaning thereby these are deliberate deposits by the builders". The layers underlying the stones in a circle are the same both on the inside and the outside. Thus all this suggests that this structure is a stupa and not a Megalith.

Conclusion

The close affinity of the structure to a stupa and discovery of a stupa railing from the same mound, establishes that it was a mud stupa. The double circle line of lateritic stone

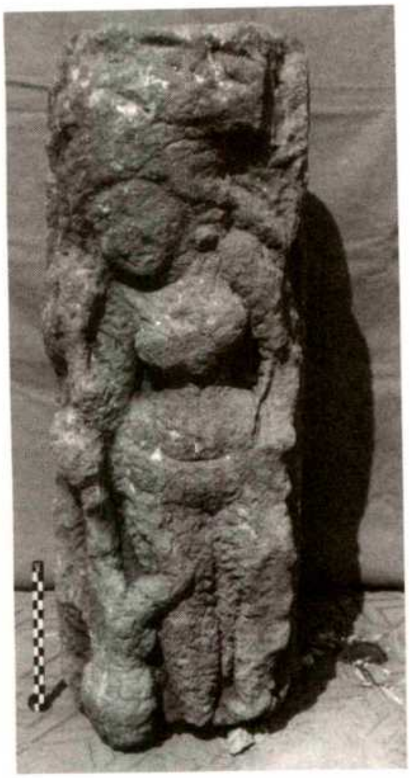

Fig. 11 Sisupalgarh: Side view of Stupa railing (26th January, 2006)

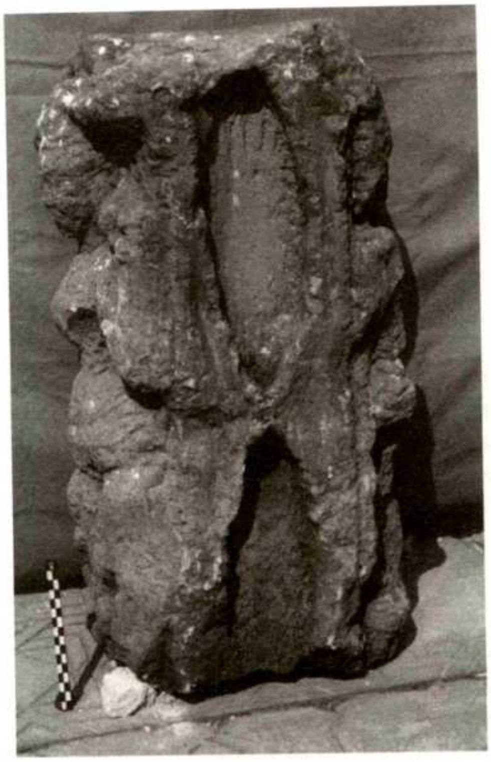

Fig. 12 Sisupalgarh: Profile view of Stupa railing (26th January, 2006)

blocks demarcates the circumference of a stupa that supported the earth filling in the middle for the raising of the *anda*. This reminds us that the early stupa structures at many Buddhist sites in the country were of mud and the present structure might be contemporary to these mud stupas.

This requires further study into archival records, and intensive investigation. This mud stupa might be of an early date and stone railings might have been added subsequently, as is the case at Sanchi, Satdhara, Sarnath, etc. There is no evidence that this mud stupa was ever veneered with stones. Hence, further investigations are required.

Acknowledgements

The author is thankful to Ms. Sandhya Dabral and Ms. Bubble Jeet for scanning the data and typing the manuscript. The photographs used are due to courtesy of the Archaeological Survey of India.

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Geomorphic and Environmental Changes around Sopara: An Early Historic Port Site in North Konkan, Maharashtra: A Review

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Abstract

Sites such as Sopara, Kalyan, Thana and Chaul on the North Konkan coast of Maharashtra, are mentioned as ports or trading centres in ancient literature. Literary records reveal that Sopara was an important port site from the Early Historic period onwards up till the early part of the nineteenth century. Sopara and Bassein were two islands separated by Sopara creek and the backwaters of the rivers Vaitarna and Ulhas in north Konkan, till the mid-nineteenth century.

Micro-paleontological and sedimentological studies reveal littoral sedimentation about 6 to 8 km inland in the area. Inland formation of *Karal* – a beach-dune complex rock, much away from the present sea, reveals inter-tidal environments in the past. The presence of *Mendha* – greenish gray tidal clay along the present day lake alignment from Bhuigaon to Sopara suggests a channel of an ancient creek. ^{14}C measurements of shells and wood indicate silting of the Sopara creek and recession of sea water within a time span of 5,000 yrs (7000 to 2000 BP). The presence of well-preserved pollen and spores of mixed vegetation type indicate high monsoonal precipitation during certain parts of the Late Holocene. Two different morphological groups of foraminifera indicate fluctuations in the monsoonal precipitation in the Late Holocene. Mesolithic artefacts were recovered for the first time in a stratified context at Gas in North Konkan. A ^{14}C date of 3500 BP on shells collected from the gravel with Mesolithic artefacts, establishes the antiquity of occupation around Sopara, which may be even older considering the secondary context of artefacts.

Introduction

This paper is based on extensive field observations and laboratory work done for the purpose of obtaining Doctorate degree (1978-81) and in 2003. The ancient port site of Sopara was studied utilizing a multidisciplinary approach, involving field investigations, sediment analysis, micropaleontology, palynological investigations, micro-morphology, chemical analysis, radiometric dating and archaeology. In three papers published earlier a few aspects were discussed in detail (Ghate 1988, 1990; Ghate *et al.* 1990). The purpose of this paper is to present the complete data collected and to provide a general picture of the geomorphic and environmental change through time around Sopara. The evidence is getting destroyed by recent development around Sopara. Hence, the author thought it necessary to publish this information.

Among many sites on the west coast of India reflecting coastal geomorphic changes, the famous Early Historical port site of Sopara (72° 48'E; 19° 24' N) (Fig. 1), provides a clear picture of the changing relationship between marine and fluvial processes. Further, the present-day inland position of the site, along with the literary records available to describe its rise and fall offer a unique opportunity to study the interplay between marine and fluvial processes operating in this area.

Several attempts to understand climatic, geomorphic changes and human history have been made along the western coast of India (Agrawal *et al.* 1973; Guzder 1980; Ghate 1988, 1990; Joglekar *et al.* 2001; Deo *et al.* 2001 and Gogte 2003). At present western coast of India comes under tropical cyclones, monsoon and west coast swell environment. Strong winds (60 to 80 % with Beaufort force 4 and 5 to10 % with Beaufort force 8) blow during July. The North Konkan belt lies within the wet zone receiving approximately 250 cm of average annual rainfall. Thunder storms occur in April-May and in late September to mid-November associated with cyclonic storms that develop in the Arabian Sea.

The western coastline of India has responded to global eustatic and climatic changes. It is important to understand changes on a localized level or regional level. Sediment samples from Nale Sopara (72° 40'E; 19° 45'N), Sopara, Gas (72° 47'30" E; 19° 23'N), Nirmal (72° 47'E; 19° 23'45" N), Bhuigaon (72° 46' 30"E; 19° 22'N) and

Received : 13-3-2007
Revised : 17-5-2007
Accepted : 1-6-2007

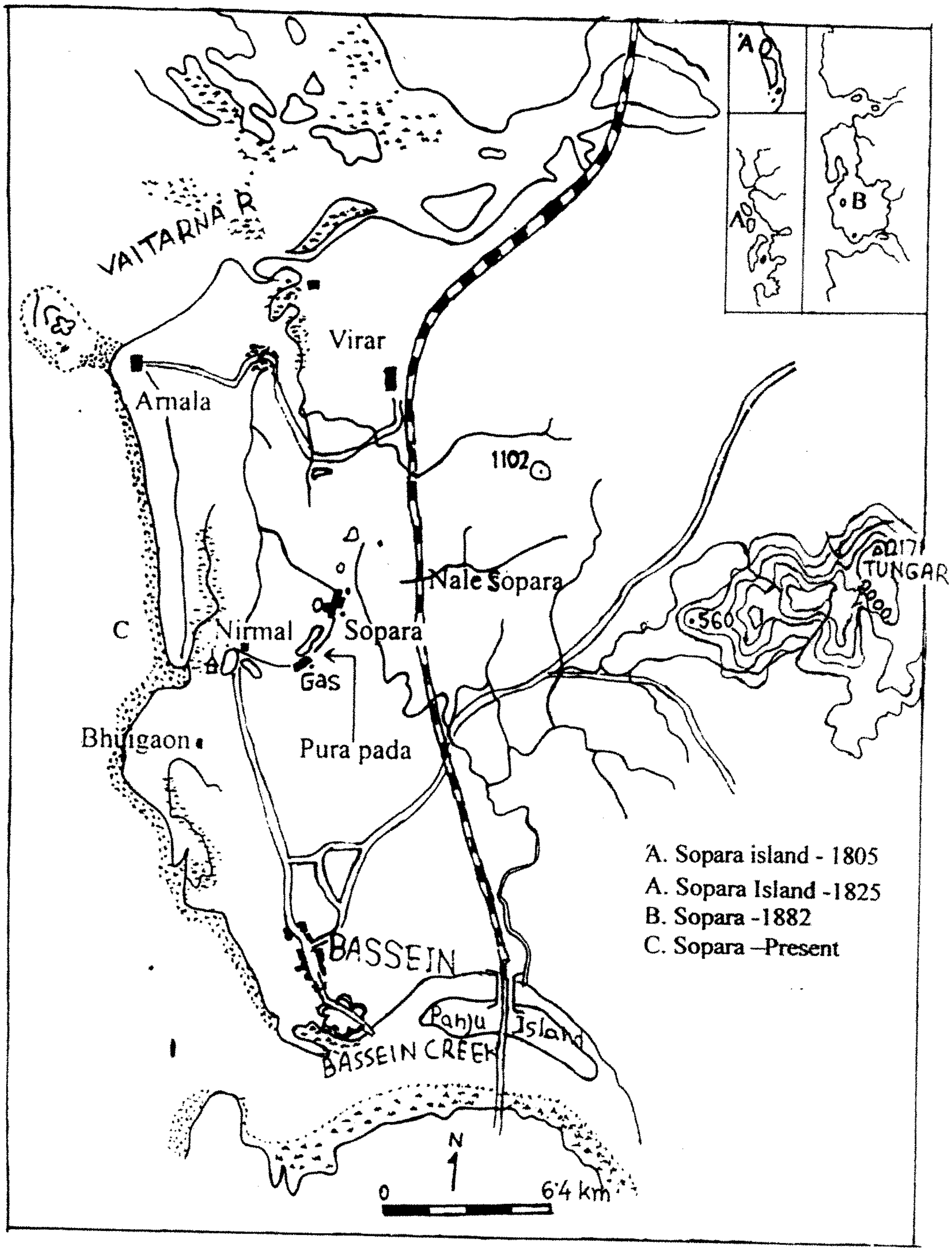


Fig 1 Location map

Purapada (72° 47'E; 19° 27' N) in North Konkan (Fig. 1), were collected and analyzed for this purpose. To understand the overall process of sea level change extensive field observations from Dahanu (72° 42' E, 20° N) in the north, to Srivardhan (73° E, 18° N) in the south were carried out.

Literary Records

Information collected from the Gazetteers of Bombay Presidency (1882) reads as follows: Under the name Shurparaka, Sopara appears in the Mahabharata as a very holy place, where the Pandavas rested on their way from Gokarna in the north Kanara to Prabhas or Veraval in south Kathiawar. The Sanskrit dictionary Yadav Kosh states that Sopara was the chief place in Aparanta. The fragment of the Eighth Edict of Ashoka found in Sopara suggests that Sopara was a capital of Aparanta in 250 B.C. Ptolemy (A.D. 150) mentions Sopara as lying between Nusaripur (Navasari) and Simylla (Chaul). The author of Periplus (A.D. 247) mentions Ouppara (Sopara) as a local mart along the coast between Broach and Kalyan. At the beginning of the 10th century, Masudi mentions Sopara as a coastal town along with Thane and Saimur (probably Chaul), where Larc dialect was spoken. In 1094, Sopara is mentioned as a port in a Silahara grant. Al-Idrisi, in the mid 12th century describes Sopara, as a mile and half away from the sea and associated with great trade. He describes it as one of the emporiums of India where Pearl fishing was practiced. Under the Portuguese, Sopara was a fortified port with four wooden stockades. Early in the 18th century the creek was fordable at low tide for except for a distance of about 1333 m between Sopara and Bolinj. An unknown traveler however was wary about the silting in the creek and suggested digging it up to a man's height. In 1837, Vaupell describes Sopara as a large trading centre, where excellent fishing boats and country vessels were built.

Sopara was the capital of Konkan from around 1500 B.C. to A.D. 1300. A part of the strip of 'garden land 'about 7 km broad that runs from Bassein creek to the bank of the river Vaitarna, separated from the mainland by an arm of the sea, 1 km in width forming backwaters to the river Vaitarna and Ulhas. It was termed as Sopara creek in the middle and Bolinj creek in the north. Small boats of ten to twelve tons (30 to 40 *Khandis*) carrying capacity navigated from the south up to Gas, which is about 4 km from the coast and as far as Bolinj, up to the middle of the 19th century. The earliest maps available for Sopara-Bassein area were prepared in 1805 (William Vincent 1998) and 1825 (Johnston 1868) (Fig. 1). The map clearly shows two separate islands, separated from the main land by backwaters of the rivers Vaitarna and Ulhas.

Sopara, Gas, Nirmal, Bhuigaon, Purapada and Nale Sopara are located in the doab region of the rivers Vaitarna in the north and Ulhas in the south, in Thana district. The north – south distance is 12 km. Sopara is the biggest township among the mentioned sites and is about 5 km away from the coast.

A field survey of coastal area between Dahanu and Chaul (73° E; 18° 33' N) was completed and samples were collected. Samples were collected from a stratified context from the localities around Sopara (Fig. 2), and were subjected to chemical, sedimentary, palynological and micropaleontological analysis. Shells and wood samples from sand, *Mendha* (tidal clay) and *Karal* (a local term for beach – dune complex rock occurring in beach and creek environments) were dated by the ^{14}C method.

Sediment Analysis

The average thickness of sediment sections is 2 to 3 m excepting at the Nirmal lake section (Fig. 2), which is 5.5 m thick. Mesolithic artefacts were recovered from a fluvial torrent gravel rich in shells from 1.20 to 1.55 m depth at the Simon de Obrey well section, at Gas. This is the only evidence of Mesolithic artefacts in the stratified context in North Konkan. Sediments in the Simon de Obrey well, rest on bedrock, while in other sections, *Mendha* forms the basal layer. The Section at Purapada is within the active creek zone and gets submerged drowns during high tide. Tidal clay rests over the sand flat at Purapada.

Based on field observations and sediment analysis of samples from six stratigraphic sections (from west to east) three main types of sediments were recorded in this area. They are as follows:

Sand: Samples range between fine sand and coarse sand, and form the upper layers in most of the sections. The thickness of sandy layer varies with location and section from a few centimetres to one metre. This is yellowish brown in colour and shell fragments often occur. Sand forms the base layer at Purapada.

Mendha or Tidal clay: Greenish gray tidal clay occurs as the top layer in case of lake sections, while in others it lies below sand/shell rich sand or moderately consolidated *Karal*. Clay contains shell fragments, pots and potsherds and wood fragments. Tidal clays are restricted in sections which are in the area of lake alignment and at the mouth of a creek (Fig. 1).

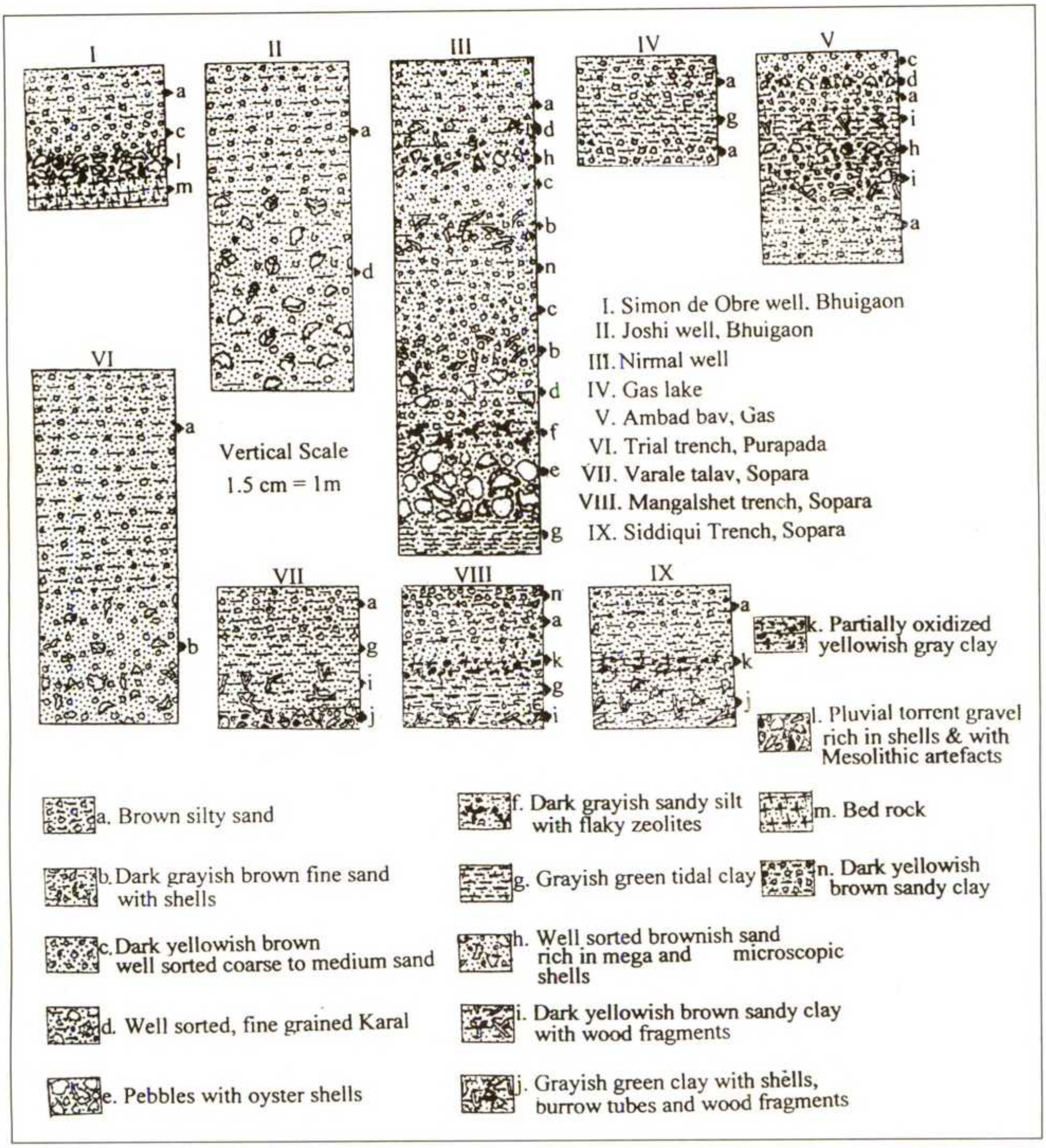
Karal: Beach – Dune complex rock, occurring in beach and creek environment (Guzder 1980). It occurs in a semi-consolidated form or in a well-consolidated form within sandy layers or below *Mendha*. It is used as a marker horizon for sea level fluctuations. In the sections at Varale talav and Joshi well, semi-consolidated *Karal*, rich in oyster shells was collected at depths of 2 m and 3.5 m, respectively.

Chemical Analysis

Organic carbon in the samples varies between 0.04 and 0.9%. Calcium Carbonate percentage is between 1.96 to 4.4%. The pH values lie between 7.3 and 8.3 and indicate the distinct saline nature of the sediments. Conductivity is between 0.16 and 1.7 m mhos. The samples with conductivity between 0.8 and 1.6 m mhos have salt concentration between 0.5 and 0.15%, which is considered as critical, slightly saline and injurious to some plants (Chopra and Kanwar 1976). Sediments with conductivity between 1.6 and 3.2 m mhos have approximate concentration of salts between 0.15 and 0.25%. This is considered hyper saline, very critical and injurious to most plants. The conductivity of the Nirmal well samples range between 0.28 and 1.7 m mhos, i.e. between normal soil and very critical soil.

Palynological Investigation

Samples were collected from the 5.5 m sequence at Nirmal and from a 1.8 m thick tidal flat adjacent to the active creek at Purapada (Fig 2). A total of 38 samples were collected from Nirmal well at intervals of 10 cm from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Vertical Scale
1.5 cm = 1m
I. Simon de Obre well. Bhuigaon
II. Joshi well, Bhuigaon
III. Nirmal well
IV. Gas lake
V. Ambad bav, Gas
VI. Trial trench, Purapada
VII. Varale talav, Sopara
VIII. Mangalshet trench, Sopara
IX. Siddiqui Trench, Sopara
VII
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VIII
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IX
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k
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k. Partially oxidized yellowish gray clay
l. Pluvial torrent gravel rich in shells & with Mesolithic artefacts
a. Brown silty sand
b. Dark grayish brown fine sand with shells
c. Dark yellowish brown well sorted coarse to medium sand
d. Well sorted, fine grained Karal
e. Pebbles with oyster shells
f. Dark grayish sandy silt with flaky zeolites
g. Grayish green tidal clay
h. Well sorted brownish sand rich in mega and microscopic shells
i. Dark yellowish brown sandy clay with wood fragments
j. Grayish green clay with shells, burrow tubes and wood fragments
m. Bed rock
n. Dark yellowish brown sandy clay

Fig 2 Lithostratigraphy around Sopara

5.5 to 3.5 m and at interval of 20 cm from 3.5 m to the surface. Eight samples at an interval of 20 cm from Purapada were systematically collected avoiding surface as well as inter-sample contamination. To avoid any fungal growth 2 to 3 drops of phenol were added to each sample. Samples were analysed using Faegri and Iverson's HF technique (1950) avoiding acytolysis. Slides were mounted in a jelly. After preliminary observations, 5 to 10 slides per sample were prepared. The pollen count is about 20 to 30 pollens per slide. Pollens were noted in all the Nirmal lake samples (Table 1). Corroded pollens were observed at the depth of 5.3 to 5.5 m. The electrical conductivity for these samples is 1.7, i.e. very critical for preservation. The pollen count is negligible in samples between the top surface and 1.9 m and from 4.7 to 4.8 m. A large number of fungal spores and algal spores were also recorded.

In the Purapada sequence, the frequency of pollen is 10 to 15 per slide. The concentration of pollen increases with depth, a maximum seen at 1.1 to 1.6 m. Samples collected from 0.0 to 0.6 m are devoid of pollens or spores.

Table 1: Nirmal lake palynostratigraphy - pollen frequency, salinity and pH

S.No.	Depth from top (m)	Brief description of Physical characters	Conductivity in m mhos	Pollen frequency	pH
01	5.5 to 5.4	Grayish sandy silt rich in flakey zeolites		10	
02	5.4 to 5.3	Dark grayish silt		06	
03	5.3 to 5.2	Dark gray or brown clayey silt		17	
04	5.2 to 5.1	Brown sandy silt		05	
05	5.1 to 5.0	Brownish shell rich fine sand		19	
06	5.0 to 4.9	Brownish fine silt sand with submicroscopic shells	1.7	52	7.9
07	4.9 to 4.8	Grayish fine silt sand with submicroscopic shells		19	
08	4.8 to 4.7	Grayish fine silt sand with submicroscopic shells		02	
09	4.7 to 4.6	Grayish fine silt sand with submicroscopic shells		40	
10	4.6 to 4.5	Brownish silt rich in shell fragments		15	
11	4.5 to 4.4	Brownish clayey silt poor in shell fragments		17	
12	4.4 to 4.3	Grayish fine to medium, well sorted sand rich in shells, resembles beach sand		21	
13	4.3 to 4.2	Well sorted, light brown medium sand poor in shells		17	
14	4.2 to 4.1	Grayish to light brown well sorted, medium to coarse sand poor in shells		30	
15	4.1 to 4.0	Grayish to light brown well sorted, medium to coarse sand poor in shells		12	
16	4.0 to 3.9	Grayish to light brown well sorted, medium to coarse sand with shells		07	
17	3.9 to 3.8	Fine to medium grayish to light brown well sorted sand		17	
18	3.8 to 3.7	Fine to medium grayish to light brown well sorted sand		10	
19	3.7 to 3.6	Grayish well sorted fine sand		22	
20	3.6 to 3.5	Grayish well sorted fine sand		05	
21	3.5 to 3.4	Grayish to light brown silt sand fairly rich in shell fragments		17	
22	3.5 to 3.3	Well sorted, grayish, medium to coarse shell rich sand	0.43	18	8.3
23	3.3 to 3.1	Brownish sandy silt	0.36	12	8.25
24	3.2 to 2.9	Grayish silt clay		20	
25	2.9 to 2.7	Grayish sandy silt		15	
26	2.7 to 2.5	Brownish silt with few shell fragments		10	
27	2.5 to 2.3	Brownish clay silt		25	
28	2.3 to 2.1	Yellowish brown silt sand with few shells		15	
29	2.1 to 1.9	Brownish fine sand with submicroscopic shells		10	
30	1.9 to 1.7	Brownish pebbly sand rich in mega-shells and oyster shells		05	
31	1.7 to 1.5	Sand, coarse, granular, rich in shells		02	8.25
32	1.5 to 1.3	Sand, coarse, granular, rich in shells	0.28	02	

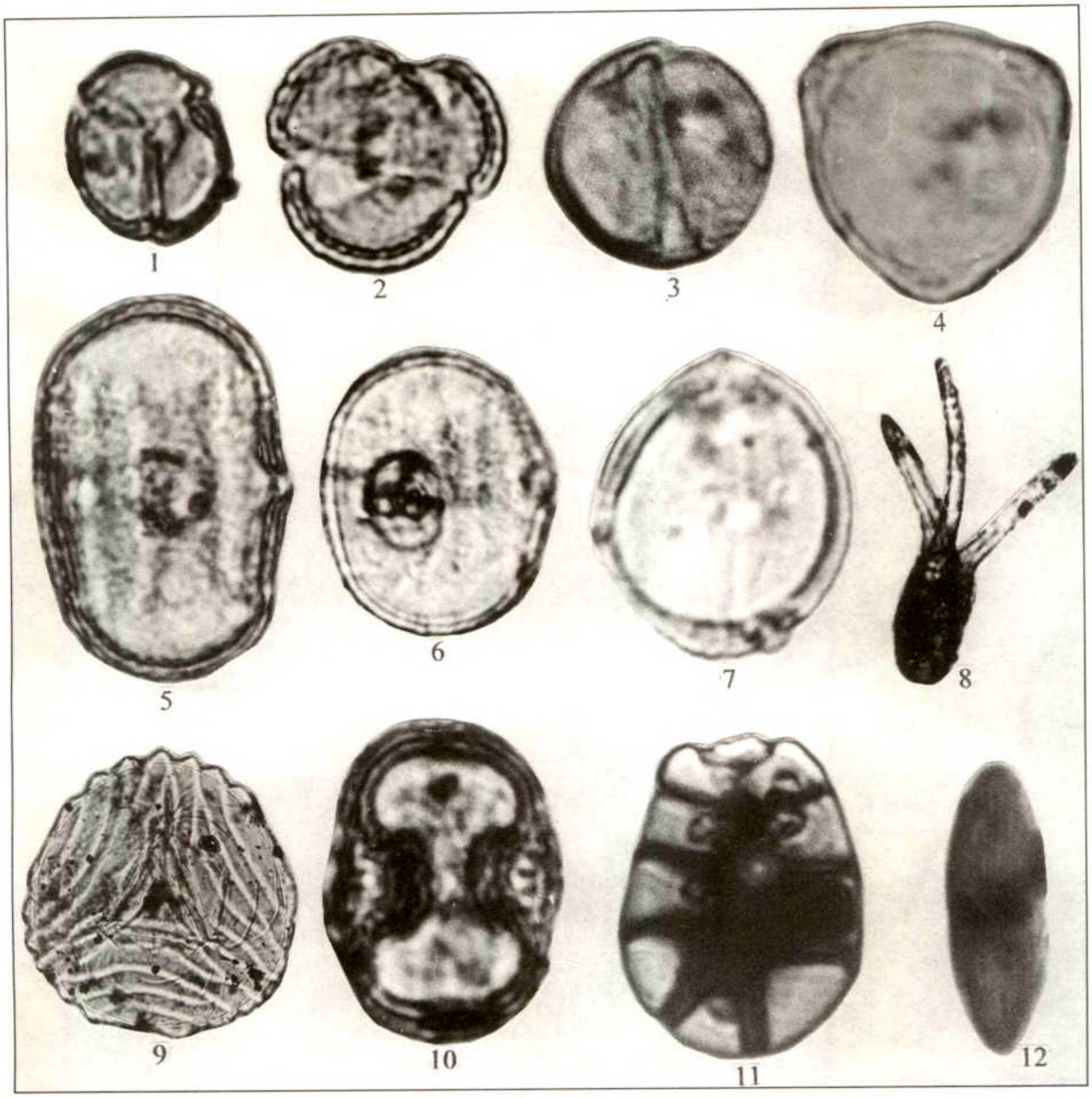

Fig 3 Pollen from Sopara

A variety of tricolpates and tricolporates, polyporates, tetrads, polyads, a large no of fungal spores and algal spores are observed in the Nirmal and Purapada samples. Pollen of families *Compositae, Myrtaceae, Euphorbiaceae, Leguminoceae, Rhizophoraceae, Accanthaceae, Cythraceae, Celrtrineae, Umbelifereae, Bombaceae, Cesalpinaceae, Micoythyriaceae, Ebenaceae and Gramineae* and Pteridophytic spores have been observed (Figs. 3-4).

Micropaleontological Findings

Samples were treated with 5 % NaOH for removal of organic matter. These samples were first dispersed with sodium hexametaphosphate and then washed with deionised water and dried. Foraminifera were mounted on a grid tray using tragacanth. Foraminifera are observed in samples collected from 1.9 to 5.3 m. They are absent in samples collected at 0.0 to 1.9 m and 5.3 to 5.5 m. Foraminifera were identified by Dr. V. Ragothaman of Dept. of Geology, Chennai University.

Samples contain benthic foraminifera. Rounded symmetrical morpho-groups are represented by *Globigerina, Ammonia beccarii, Elphidium excavtum, Elphidium hispidulum, Cibicide, Discorbis species, Rosalina* and *Noninella turgida*. Angular asymmetrical morpho-groups are *Bolivina sin, Bolivina concallorium, Boliverina capitata or Boliverina rhombiodolisand Florilus boueanum.* Other forms are *Massilina, Miliolinella, Quinquiloculina rugosa, Uvigerina species, Fissuruina Species, Pseudopolymorphina, Lagena striata, Buliminella* (Fig. 5).

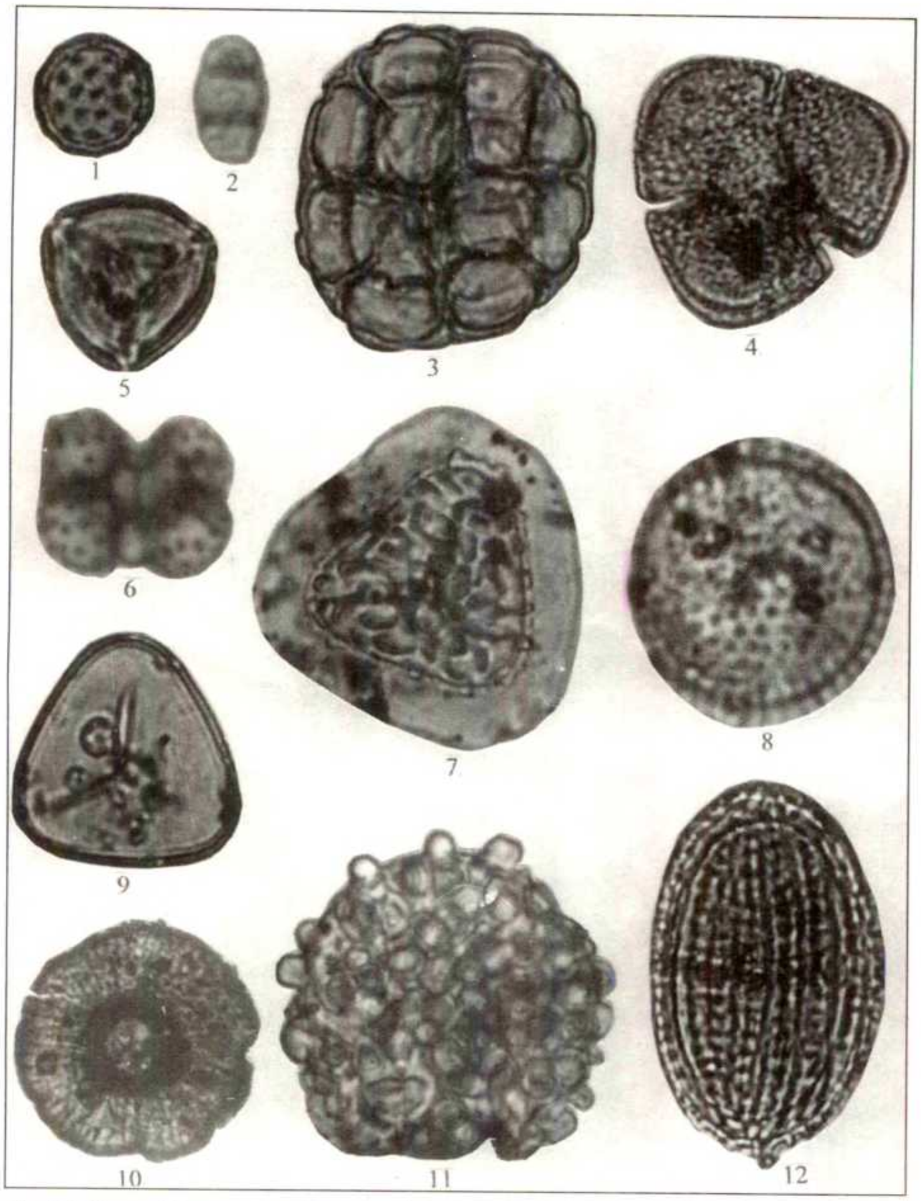

Fig 4 Pollen and Spores from Sopara

Micromorphology of Karal

Thin sections of Karal samples were studied under polarized microscope. The staining technique by Dickson (1965) was followed. This technique was found to be easier and faster in identifying calcite, ferron calcite, aragonite, etc. Thin sections were described following Bullock *et al.* (1985). The results of petrographic studies are given in Table 2 and Fig. 6.

Radiometric Dating

Eleven calibrated ^{14}C dates were provided by G. Rajagopalan of Birbal Sahani Institute of Palaeobotany, Lucknow. These dates are expected to be closer to the true values. Out of eleven dates, five are on shells separated from Karal at localities Gas and Joshi well (Bhuigaon), Simon de Obrey well (Bhuigaon) and Mangalshet trench (Sopara); five dates are on wood fragments collected (one sample each) from Varale Talav (Gas), Siddiki trench (Sopara), Ambad bav (Bhuigaon), Bhatia trench (Nale Sopara) and Mangal shet trench (Sopara); one date is on a peat sample from Ambad bav (Bhuigaon). Dates on shells are between 5379 and 2838 BP. Dates on wood are between 7056 and 4501 BP. A single date on a peat sample is 6613 BP (Table 3, Fig.7).

Archaeological Evidence

Mesolithic blades were recovered for the first time from a stratified context in North Konkan from the Simon de Obrey well section at Bhuigaon (Fig. 8). Mesolithic basalt blades were found at a depth of 1.55 and resting on bed

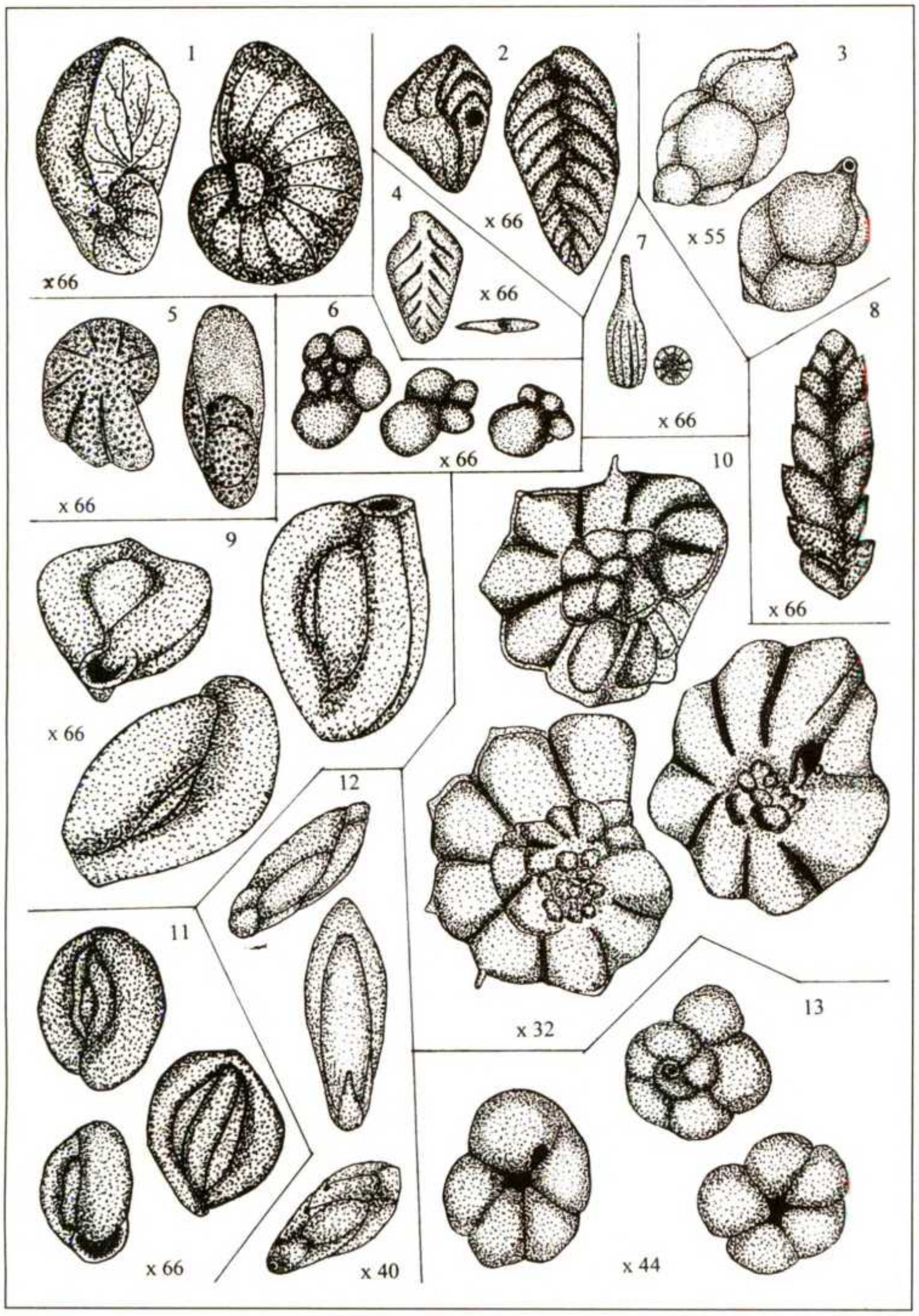

Fig 5 Foraminifera found at Sopara

rock within a fluvial torrent gravel rich in shells, dated to 3358 BP. Microliths made of chalcedony, were also collected as a surface spread on a small hill in this area. A Satvahana period brick-wall was observed along the fence of one of the bettlenut garden at Gas. Two storage jars and a ring well of Satvahana period were found embedded in a 4 m thick sediment at the old landing site of Bhuigaon. Early Historic and Historic pots were recovered from the Gas lake sediments (Figs. 9-10). Ganesh (Fig. 11) and Shiv-Parvati idols of the 13th century were recovered from a small tank known as Bholyacha talav at Bhuigaon. A few potsherds of the Satvahana period and shells were collected from a trial trench taken at Sopara.

Discussion

Sopara today forms an extended suburb of Mumbai. Quaternary deposits of this area are represented by *Karal*, and *Mendha* or tidal clays. *Karal* was classified by Guzder (1980) as: a) true inter-tidal beach rock, b) beach-dune clcarenite, and c) aeolinite. The megascopic characters of

Table 2: Micromorphology of *Karal* samples

Site	Texture	Type of Cement	Mineral Content	Clay pellet %	Microfossils
Gas	Floating texture, biomicritc	Micritic Calcite	Pyroxenes, zircons, hornblend, olivine, iron pellets,l imonite, magnatite and hematite	15 to 20	Foraminifera intact Coralline algae coated with microcrystalline calcite
Dahanu	Fine grained, biomicritic	Spary clcite, biomicritic calcite fibrous calcite	Plagioclase, microcline, Opaques, quartzites, clay Pellets	2 to 5	Shells shattered
D Naik's well, Chaul	Fine grained, micritic	Skeletal debris, Micritic calcite, Meniscus	Ferromagnesium grains of limonite, haematite, magnetite, amphiboles	20 to 25	Molluscan shells partly dissolved
D Naik's well, Chaul	Fine grained, micritic	Crystal calcite	Opeques, trap rock fragments	2 to 5 Ferruginuous pellets	Broken shells
D Naik's well, Chaul	Fine grained, micritic	Micritic calcite, crystal calcite or Spary calcite	Olivine, amphiboles	Traces	High proportion of intact foraminifera and molluscan shells, internal sediments lying with fragments lying with aragonite crystals
Mhatre's well, Nagaon	Floating texture, micritc	Secondary calcite, Aragonite, micritic calcite	Plagioclase, microcline, augite, ferroaugite, opaques	Traces	Gastropod shells filled with micritic calcite, shell fragments lying with aragonite crystals
St. Mary's High School, Dhanu	Fine grained	Crystalline, inequant calcite	Feldspars, trap fragments	5 to 10	Miliolid, planctonic foraminifera, cambered gastropods, occasionally broken cambers, spicules, spines

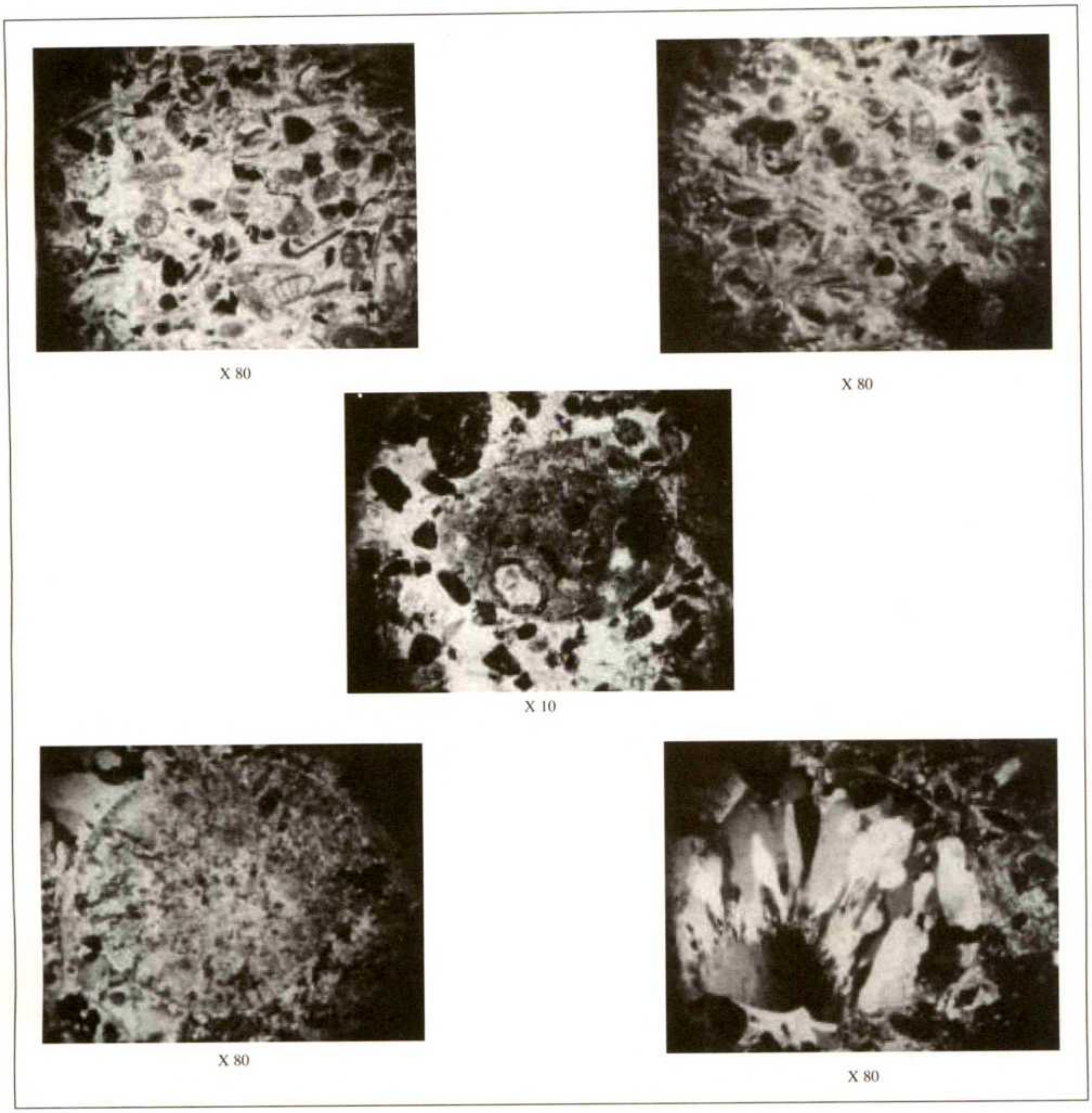

Fig 6 Micromorphology of *Karal*

all types of *Karal* are more or less similar, yet they can be divided into two categories: a) coarse grained with large shells, b) fine grained with submicroscopic to microscopic shells. *Karal* exhibits horizontal laminations (4-6 mm thick). Based on the micro morphology of *Karal* samples collected from various localities from Dahanu to Chaul, the author has further classified them into four types:
a) biomocritic limestone, b) oolitic limestone, c) planktonic organic bound limestone and d) fusilinid limestone.

Karal, is used as a marker for high/low sea level. Guzder (1980) produced a large number of ^{14}C dates from north and south Konkan, all of which were on samples collected along the coastal area in inter-tidal zone. The author dated 11 samples (^{14}C) from across the costal area. This enabled the author to postulate about the nature of sea level change in the area.

The presence of *Karal* at distance from 2 to 5 km inland and the calibrated ^{14}C dates ranging between 5379 and 2838 BP; point out to influx of sea water during this period. The *Karal* however, is restricted to a narrow stretch along one west-east axes, from Bhuigaon to Nale Sopara. This suggests a creek channel, active during that period. A simple geomorphic exercise, of joining the lakes shown on the topographic sheet at Bhuigaon, Gas, Nirmal and Nale Sopara, corresponds well with the alignment of locations with *Karal*.

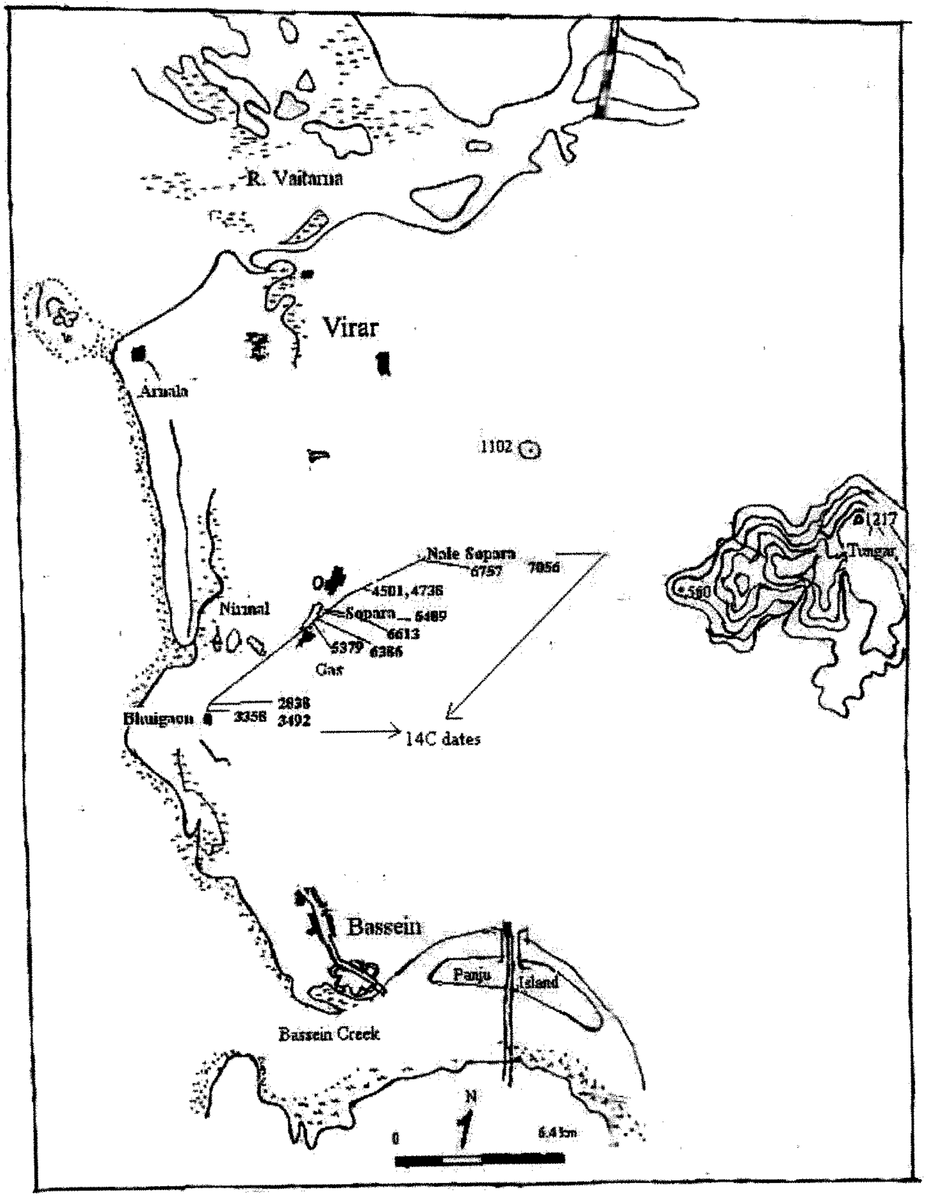

Fig 7 Locations where ^{14}C dates are available

Samples collected along the lake alignment were tested for foraminifera. Their presence justifies the observations made on *Karal* and proves presence of a creek flowing in a west-east direction and separating the area between two islands. Thus, present-day lakes around Bhuigaon, Gás, Nirmal and Sopara are truly the remnants of this ancient creek.

The ^{14}C dates of these sediments suggest an active creek around 7,000 B.P. Thus Sopara and Bassien were islands from 7,000 B.P. to A.D. 1868, as shown also in the Handy Royal Atlas (Johnston 1868). The decreasing trend of ^{14}C dates on wood samples, with an older date of 7,056 B.P. at ~ 8 km from the coast and younger date of 4501 B.P. at ~ 5 km (Fig. 7) from the coast suggest a gradual silting up of the creek. A similar trend is observed in case of dates on marine shells. Silting within the time span of 3,500 years is indicated in both cases.

Sea level fluctuations along the Sopara coast were observed by Ghate (1988). In 1995, Hashimi *et al.* explained the nature of sea level fluctuation on the western Indian continental margin specifically on the Khambat coast (Fig. 12). According to them the sea level was at 80 m depth around 12,500 years. Subsequently, the sea level remained unchanged almost for 2,500 years. From 10,000 years to 7,000 years it rose with a rate of ~ 20 m/100 years. After 7,000 BP the sea level fluctuated to around the present level and the present sea level around Sopara area was attained around 7,000 B.P.

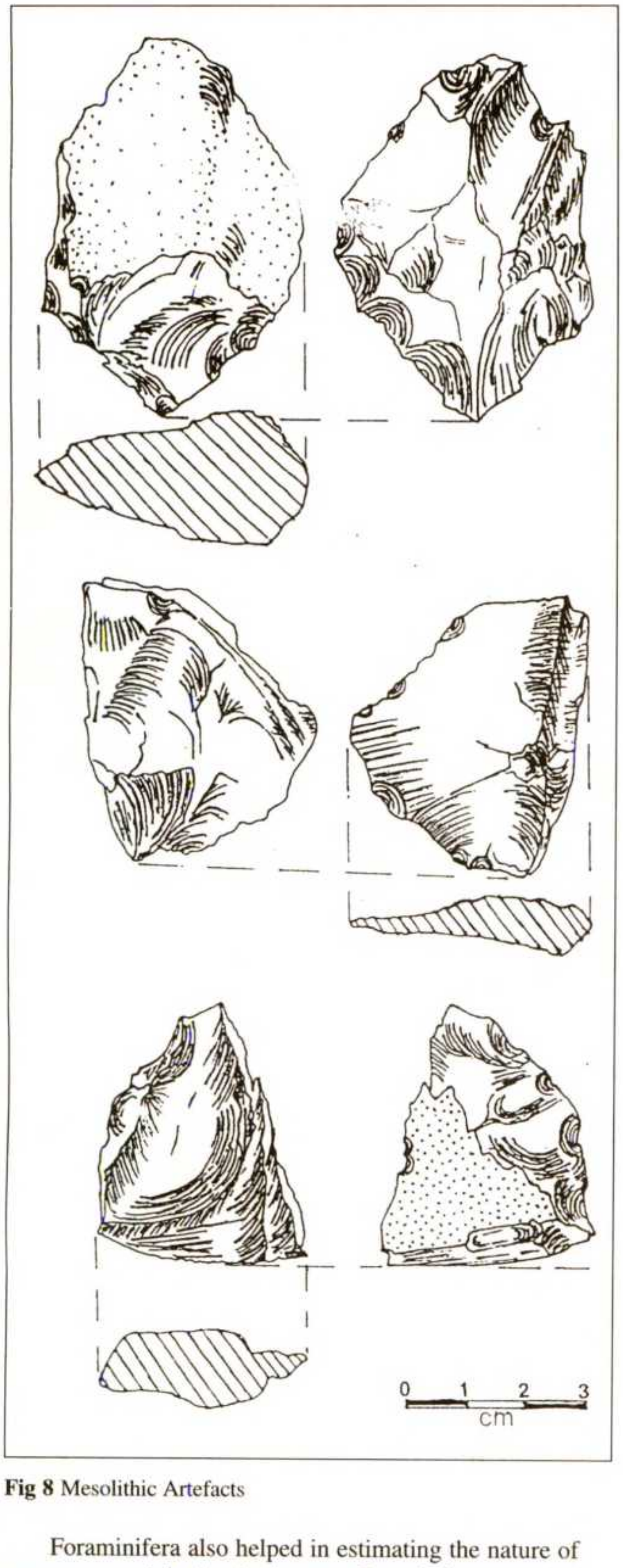

Fig 8 Mesolithic Artefacts

Foraminifera also helped in estimating the nature of monsoon precipitation in the area. Rounded symmetrical and angular asymmetrical morpho-groups of benthic foraminifera are present in the samples analyzed. Comparative study of these foraminiferal morpho-groups was done by Nigam *et al.* (1992), on the coast of Karwar and Goa. They established a direct relation between good monsoon precipitation and population of rounded asymmetrical morpho-groups. The population increases with an increase in fresh water. They concluded that foraminifera are good indicators of fluctuations in monsoonal precipitation. In the present study area rounded symmetrical morpho-groups out-number against angular asymmetrical morpho-groups, in samples collected at the depths of 1.5 to1.7 m, 2.5 to 2.7 m, 3.3 to 3.5 m at the Nirmal well section, indicating an increase in monsoonal precipitation. While a greater number of angular asymmetrical morpho-groups in the sample collected at 4.9 to 5.0 m, suggest reduction in precipitation.

Increase in precipitation can also be inferred from the well-preserved plant debris observed in samples at the Nirmal well section and Purapada. The palynoflora recorded is heterogeneous, and mainly represented by the plant groups of pteridophytes and angiosperms. Similar heterogeneous palynoflora were reported by Kumaran *et al.* (2001), at Dhamapur in south Konkan. On the basis of the dominance of pteridophytic spores, angiosperm pollen and various fungal elements; they suggest that the area was densely vegetated, receiving heavy precipitation along with greater atmospheric moisture at the time of deposition.

Increase in precipitation also results in increase in suspended sediment load. Thus, excess load must have been brought down by Sopara creek, originating in the Tungar Hills and also by the backwaters of rivers Vaitarna and Ulhas, during periods of increased precipitation. A high west coast surge in the monsoon period may have restricted the seaward flow of sediments. This may have resulted in settling of sediments inland, thus silting the creeks. The ultimate result of this was configurational changes with, progression of land and apparent regression of the sea.

Evidence of Palaeolithic occupation in the North Konkan coast is sparse. Mesolithic sites around Mumbai were first reported by Todd in 1950. Mesolithic artefacts in stratified context were reported for the first time by the author in 1988 and were found in shell-rich gravel at Gas, Sopara, dated to 3,500 BP. Artefacts found at Gas are in a secondary context, thus, Mesolithic occupation may be much older. Material evidence and literary records suggest that Sopara area was continuously occupied from 1500 B.C. onwards.

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Table 3: ^{14}C dates of *Karal** (Ghate 1985)

Sample No.	Depth from Surface in meters	BSIP No.	Site name and location	Position to Relative datum MSL (in m)	Material	Age** Years BP (^{14}C half life: 5730 yrs)	Description of the sediment
01	4.0	311	Gas lake 19° 24′ 15½ N 72° 48′ E	+ 1	Shell	5379	*Karal*: moderately cemented, shells partially broken
02	4.0	378	Joshi well – Bhuigaon 19° 22′ 50½ N 72° 46′ 30½ E	+ 2	Shell	3492	*Karal*
03	3.5	381	Joshi well – Bhuigaon 19° 22′ 50½ N 72° 46′ 30½ E	+ 2.5	Shell	2838	*Karal*
04	1.5	411	Simon D'Obrey well – Bhuigaon 19° 22′ 30½ N 72° 47′ E	+ 3	Shell	3358	Torrential gravel rich in shells and few unrolled Mesolithic artefacts
05	1.3	412	Varale talav – Gas 19° 24′ 30½ N 72° 48′ 25½ E	+ 1	Wood	6489	*Mendha*
06	2.0	413	Siddiki trench – Sopara 19° 25′ 16½ N 72° 49′ E	MSL	Wood	6757	Shell layer
07	1.7	441	Mangal Shet trench – Sopara 19° 25′ 10½ N 72° 48′ 30½ E	MSL	Shell	4738	Shell rich sand
08	1.7	443	Ambad Bav – Gas 19° 24′ 30½ N 72° 50′ E	MSL	Wood	6386	*Mendha*
09	1.8	444	Bhatia trench – 19° 23′ N 72° 50′ E	MSL	Wood	7056	*Mendha* with Bassein shells, burrow tubes and wood fragments
10	1.7	449	Mangal Shet trench – Sopara 19° 25′ 10½ N 72° 48′ 30½ E	MSL	Wood	4501	Shell rich sand
11	1.0	451	Ambad Bav – Gas 19° 24′ 30½ N 72° 48′ E	+ 1	Peat	6613	*Mendha*

** ^{14}C ages have been multiplied by 1.03 to get calibrated ages.

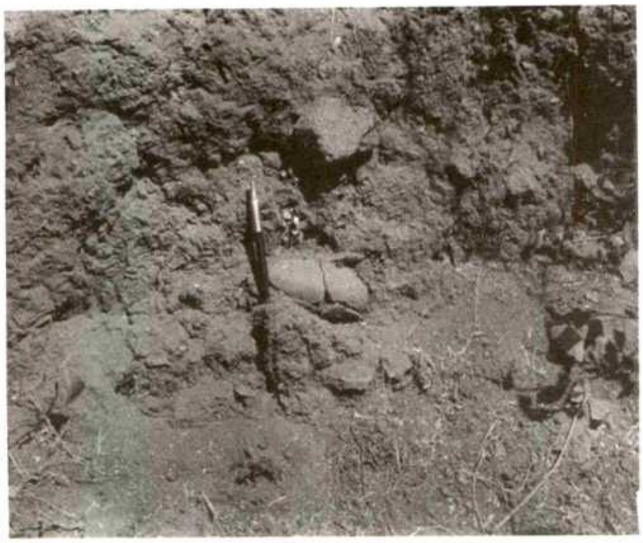

Fig 9 Historic pot embedded in sediment – Gas lake

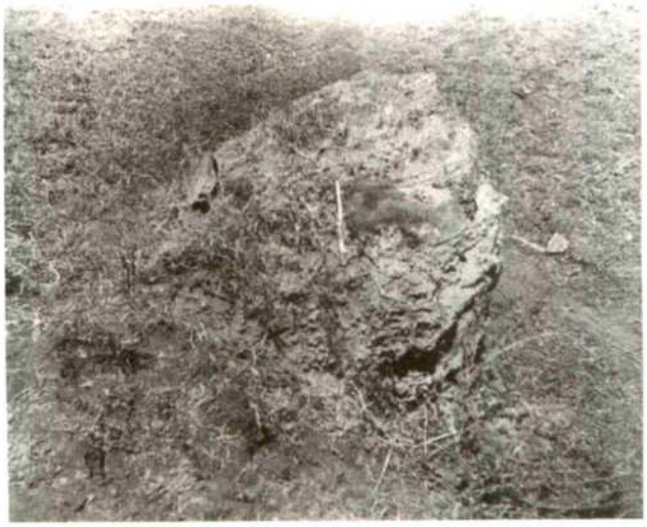

Fig 10 Early Historic pot embedded in sediment – Gas lake

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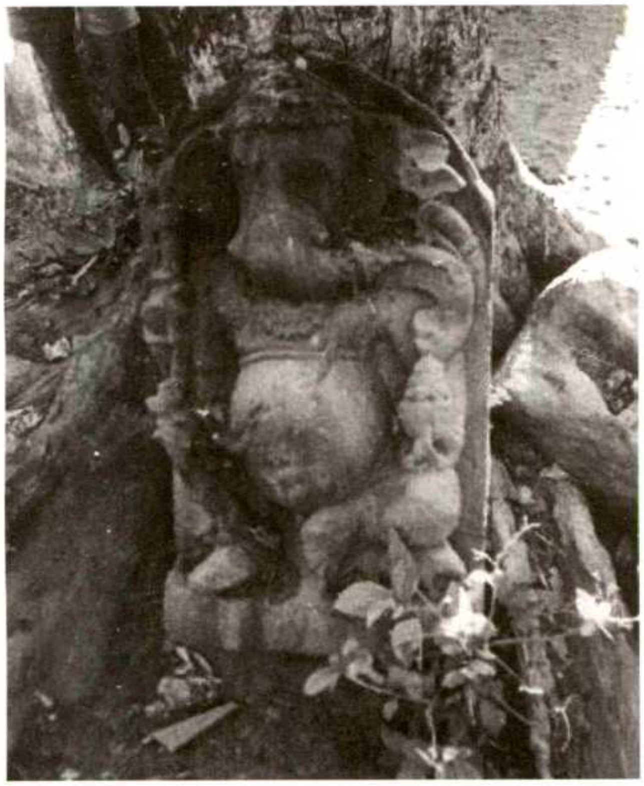

Fig 11 Ganesh – 13th century

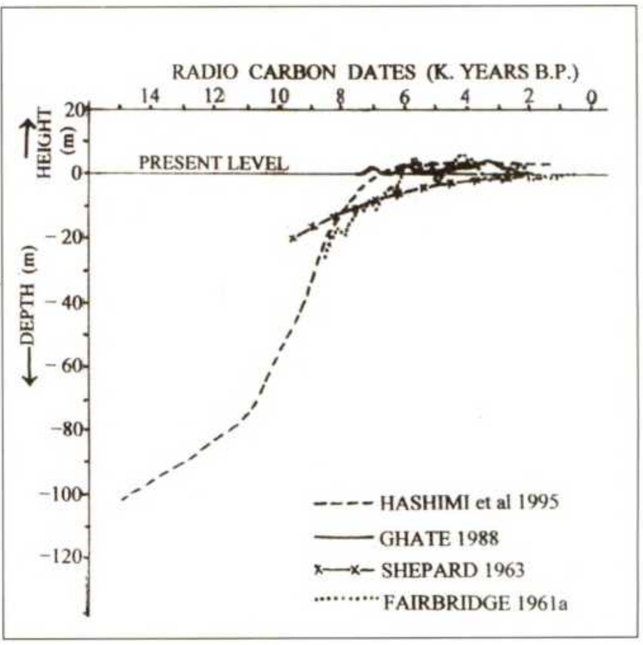

Fig 12 Holocene sea level curve

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H.P. Ray and S. Ravindranath, *Man and Environment* XXXII(1): 89-101 [2007].
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The Archaeology of Ritual Spaces: Satellite Images and Early Chalukyan Temples

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Abstract

The objectives of this paper are twofold: one, to highlight the complex factors that led to the emergence of the Malaprabha valley as the core area under the Chalukyas in the 7th century A.D.; and second, to understand the landscape as defined by diverse religious shrines. In this endeavour, high-resolution satellite images have proved an invaluable source in situating the temples within their geo-physical habitat and it is the results of this collaborative venture that are presented here. The paper is divided into three sections: in the first part, we discuss details regarding the background of the temples and their dynamic archaeology that provides insights into resource use and their wider hinterland, while the second section highlights the diverse uses of ritual space by highlighting the cult of Lajja Gauri, which shared sacred space with the Hindu, Buddhist and Jain temples in the Malaprabha valley, as also with memorial shrines. The final section focuses on the close proximity of religious shrines to water bodies, which provide linkages between the sacred and the temporal.

Introduction

He having erected a temple, an abode of the great Visnu (mahavisnugrham), surpassing everything that is celestial or human, fashioned with most curious workmanship, most worthy to look at and having given rich gifts to brahmanas on the holy full moon day of the month of Karttika granted on the occasion of the installation of the image of the holy Visnu the village of Lanjisvara, having made a daily observance, the bestowal of food and alms upon sixteen brahmanas for the purpose of offering oblation (bali) to Narayana and having set apart the remainder for the sustenance of wandering religious mendicants. The reward of this religious merit was made over to his elder brother Kirtivarma in the presence of the Sun (aditya) Fire (agni) merchants (mahajana) (6th century A.D. inscription of Chalukya king Mangalisa, the son of Pulakesi I in cave III at Badami, north Karnataka).

This sixth century A.D. epigraph is symptomatic of the complex process involved in the construction and consecration of temples. On the one hand, royalty made donations for temple construction and recorded these in stone on temple walls for all to see. Secondly, both the brahmanas and wandering religious mendicants involved in the consecration of the shrines were also recipients of the king's generosity. Thirdly, after construction was completed, the image was installed in the shrine on an auspicious day amidst festivities and finally was the transference of religious merit earned through this act to relatives, in this case an elder brother. The temple had thus acquired multiple meanings, which impacted society in a variety of ways (Ray 2007).

This paper shifts the focus of study from the social context of the temple to its location and the extent to which religious architecture defined the landscape ascribing it with sanctity and cultural identity. This inviolability of this religious landscape long outlived the patrons of the temples and was sustained by constant reinvention of the monuments by communities who lived in the vicinity. Thus the objectives of this paper are twofold: one, to highlight the complex factors that led to the emergence of the Malaprabha valley as the core area under the Chalukyas in the 7th century A.D.; and second, to understand the landscape as defined by diverse religious shrines. In this endeavour, high-resolution satellite images have proved an invaluable source in situating the temples within their geo-physical habitat and it is the results of this collaborative venture that are presented here.

Two adjacent scenes of satellite images IRS P6 LISS IV of March 2005 covering 23 x 23 km of each scene have been used for preparing the layout of the derived maps. Multi-spectral data of 5.8 m spatial resolution provides the base map of the region, while panchromatic data of 2.5 m spatial resolution allows location of the temples at Aihole. Additional information on the temples has been geo-referenced and a series of maps generated that indicate the spatial context of the variables used (Fig. 1).

At both ends of the 25 km long fertile valley of the Malaprabha river (a tributary of the Krishna) in Bagalkot

Received : 7-4-2007
Revised : 19-5-2007
Accepted : 25-5-2007

district, the hills close in and Badami lies some distance outside the southern entrance to the enclosed terrain. Here, between the cliffs there is a huge tank and temples are scattered around this water-body. Aihole (Aryapura/ Ahivolal) is located at the opposite entrance to the valley and in the middle of the valley lies Pattadakal (ancient Kisuvolal), where a complex of temples was built on the banks of the Malaprabha, which at this point runs auspiciously from south to north. Mahakuta lies five kilometers east of Badami as the crow flies in a cleft in the hills and continues to be a place of pilgrimage, with most of the shrines built around a sacred tank within a walled enclosure. Other significant places include the site of Naganatha temple, in the forested area, rock shelters at B.N. Jalihalla and Siddhanakolla on the hills near Aihole, Sandur in Bellary district, Banavasi, the ancient Kadamba capital, Kudaveli Sangam, Satyavolu and Alampur, 150 km or so to the east.

Seven out of hundred and forty temples bear an inscription recording a dedication of the royal family of the Chalukyas and three of these are at Pattadakal, two at Badami, one at Mahakuta and one at Alampur. What then was the role of the kings, considering that very few temples provide evidence of being patronized by the ruling elite? A response to this question necessarily involves an examination of the unique spatial context of these sites and the diverse nature of these shrines, which were not only dedicated to a host of Hindu, Buddhist and Jain deities, but also owed affiliation to fertility cults such as that of Lajja Gauri. The beginnings of many of the sites date to a prehistoric past and indicate continuity in terms of the sanctity attributed to the locale, as well the use over time of water-bodies, such as tanks fed by underground springs. Of crucial importance to this paper then is the archaeology of the monument, which, however, cannot be understood solely in terms of linear time and needs to be situated in terms of space.

Space and time are two significant dimensions of the study of religious architecture, and both must be considered together. Satellite imagery and elevation data transform the "map" from a simplified diagram into what is effectively a photograph or a three-dimensional representation, conveying a much more effective sense of place. In addition, when data and imagery are geo-referenced, i.e. tied to a common global co-ordinate system, they can be combined using Geographic Information Systems (GIS) to analyse and examine a range of issues. Satellite images thus provide a convenient means of understanding why early sites were chosen for religious architecture, and in visualising the linkages between them. One of the primary issues in a study of the past is not merely to locate sites accurately but more importantly to relate these to other sites in the region. This is especially important in the context of the temple complexes of Aihole, Badami and Pattadakal. It is also significant that the setting up of the religious sites not only altered the physical and cultural landscape of the Malaprabha valley in the 7th-8th centuries A.D. but also these structures continued to be altered and reinvented. This paper locates intersections of these different time-scales horizontally across the valley for an appreciation of the extent to which the early religious shrines shaped the landscape.

The paper is divided into three sections: in the first part, we discuss details regarding the background of the temples and their dynamic archaeology that provides insights into resource use and their wider hinterland, while the second section highlights the diverse uses of ritual space by highlighting the cult of Lajja Gauri, which shared sacred space with the Hindu, Buddhist and Jain temples in the Malaprabha valley, as also with memorial shrines. The final section focuses on the close proximity of religious shrines to water bodies, which provide linkages between the sacred and the temporal. It is hoped that this paper will generate interest in the utilisation of scientific tools both in understanding as well as in protecting our cultural heritage.

The Setting

The early Chalukyan sites of Aihole, Badami and Pattadakal are located in Badami taluka, Bagalkot district of north Karnataka and the average elevation in this area reaches approximately 610 m (Fig. 2). The sites are surrounded by uplands of the Kaladgi series with several outcrops of granite-gneiss in-between. Tributaries of the Krishna river system, such as the Ghataprabha and the Malaprabha, dissect the region. The spread of Black soil is ideal for the cultivation of cotton, jowar, groundnut, maize, bajra, wheat, sugarcane and tobacco. The district is also rich in mineral wealth and copper is found at the village of Kaladgi, located 24 km from the town of Bagalkot, while iron ore exists in the southern part of the district. The Hatti gold mines in Raichur district, east of Aihole are known to have been used since the 9th century B.C. as indicated by radiocarbon dates.

Archaeologically, the earliest finds in the valley date to the Palaeolithic period and a complex assemblage of tools ranging from crudely made forms to very fine artefacts are known from the same horizon (Joshi 1955). Lower Palaeolithic tools, such as handaxes of quartzite were collected near Rachi Gudi temple at Aihole (IAR 1975-76: 21). Extensive outcrops of laterite have been observed in an area of about 15 to 20 km^2 around Badami town, while finds of Lower Palaeolithic tools are associated with alluvial formations. These rich Acheulian sites around Badami represent open-air occupation-cum-factory sites. Rock paintings and Mesolithic occupation are reported from the Siddhalaphadi rock shelters near the town, which show evidence of prolonged use as indicated by finds of microliths, pottery, graffiti, and inscriptions on wall in white over red background dated to 5th-6th century A.D. (IAR 1955-56: 5; 1980-81: 27-29).

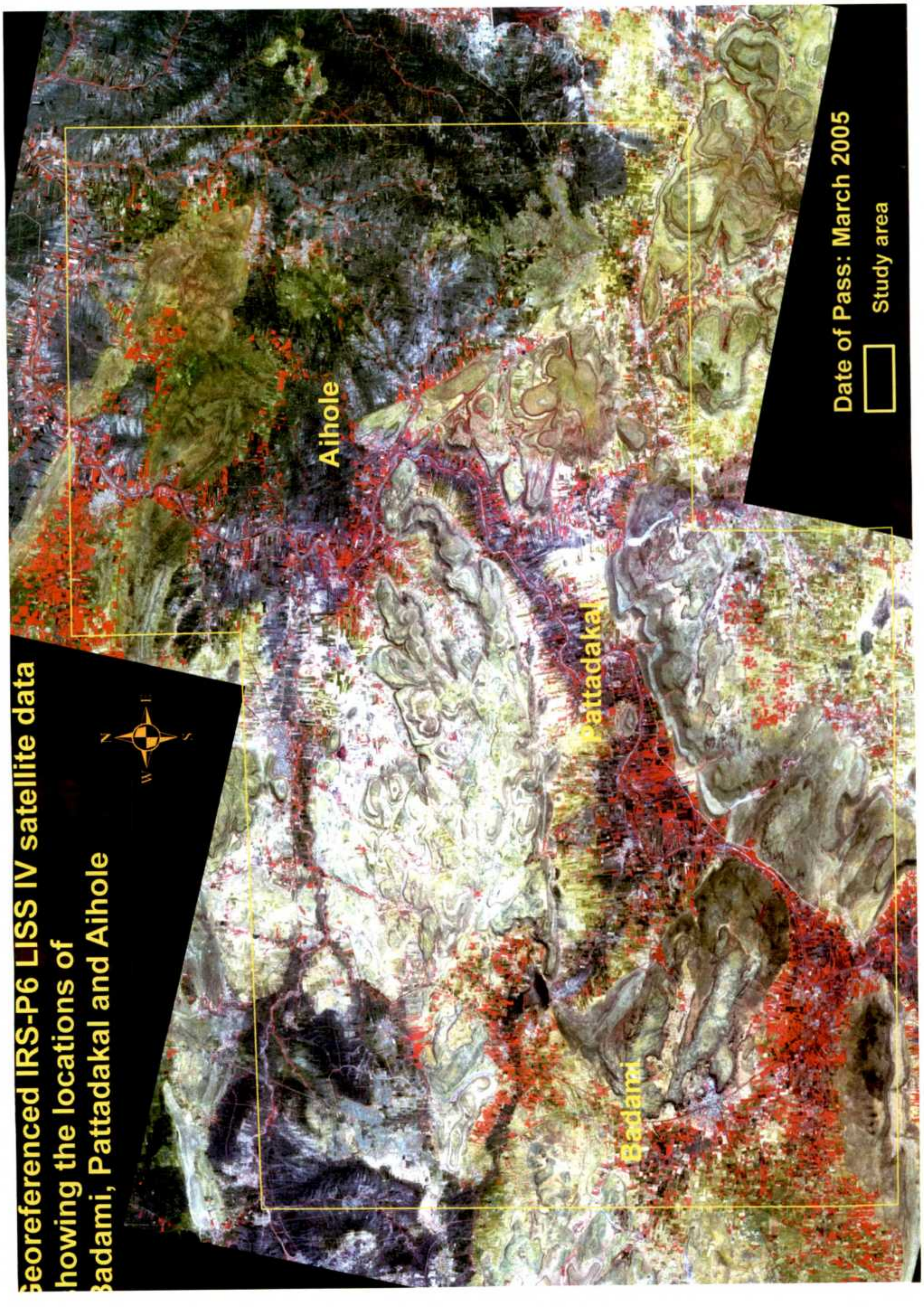

Fig. 1 The study area

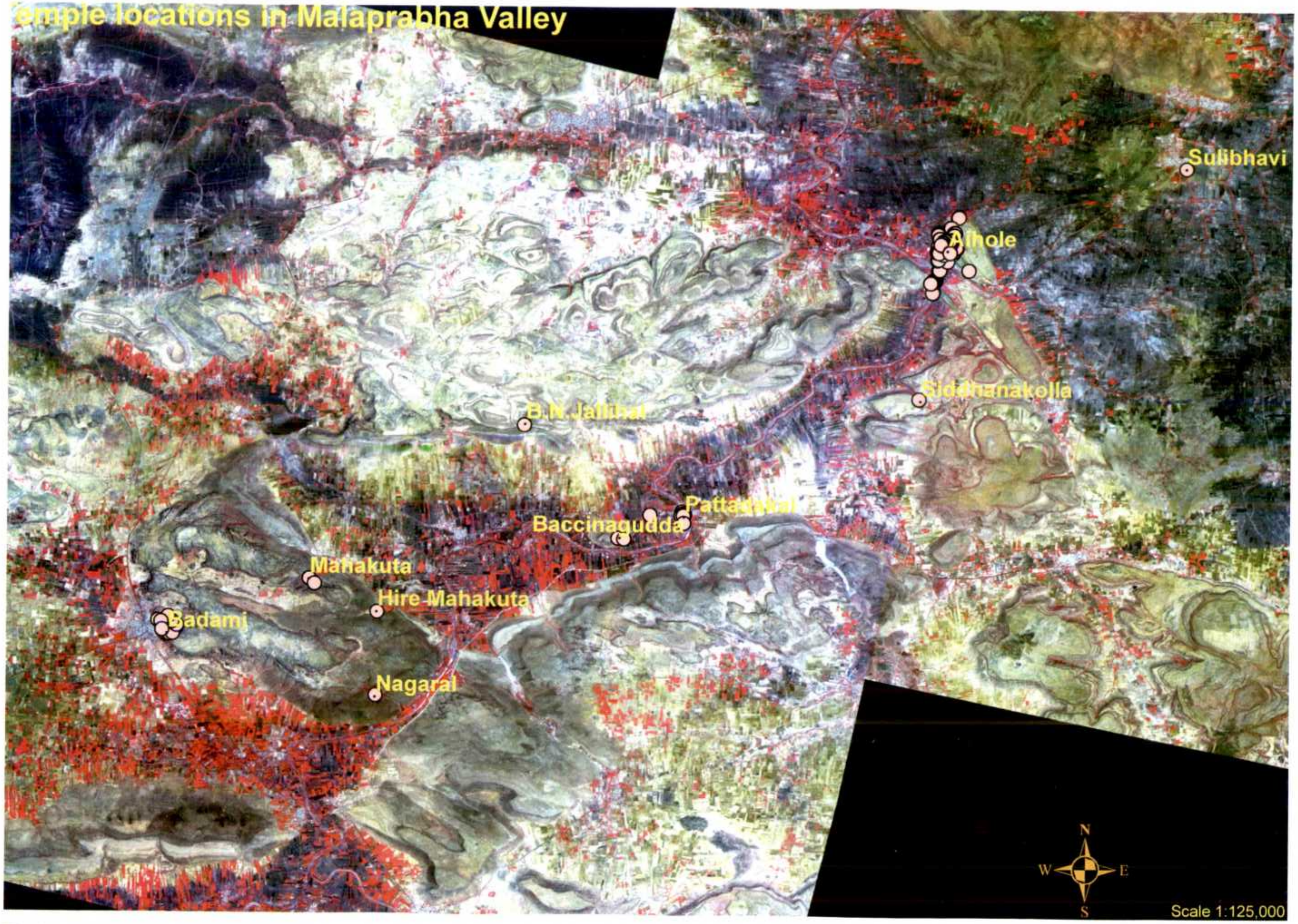

Fig. 4 Major temple sites in Malaprabha Valley

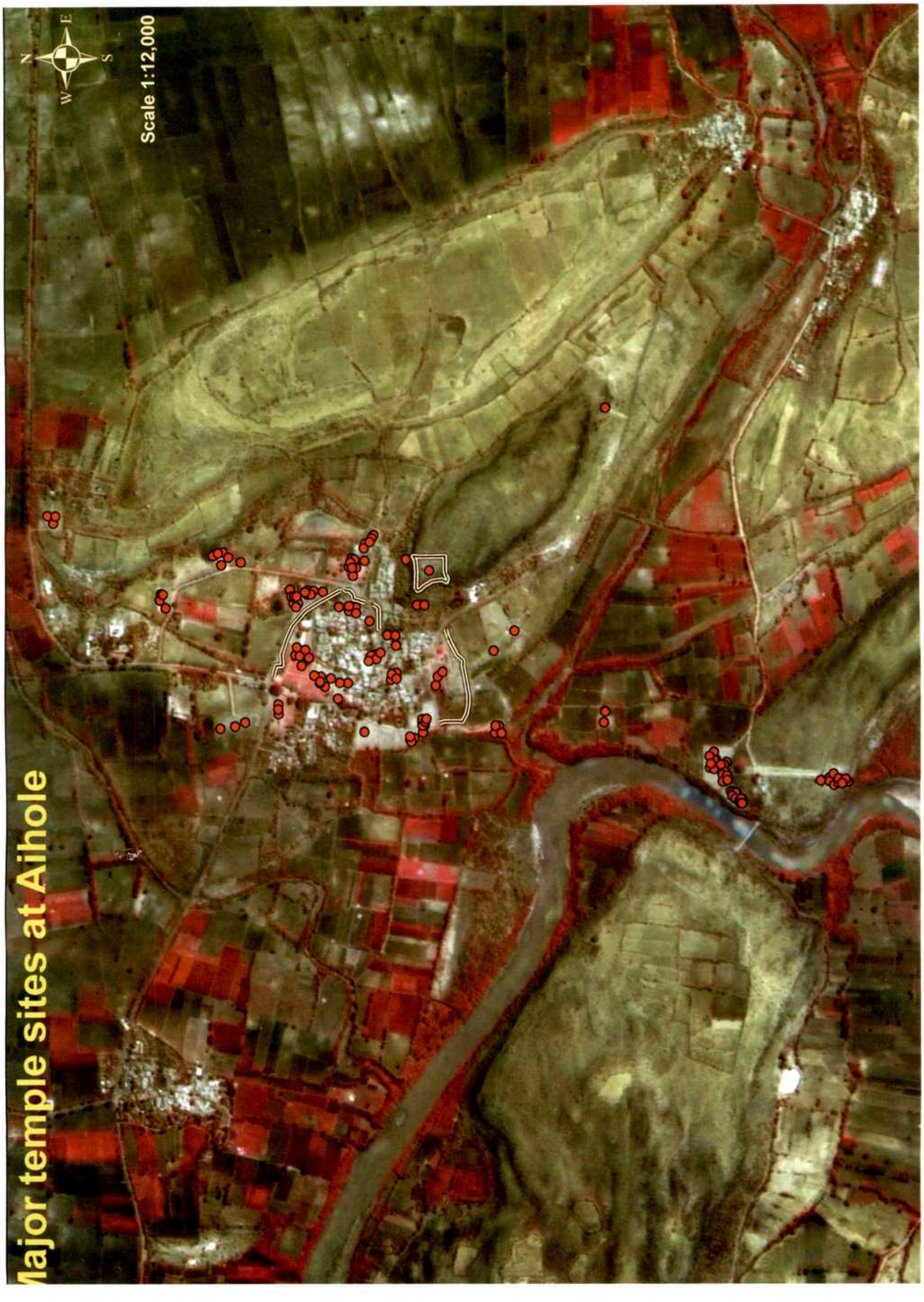

Fig. 5 Papanath temple at Pattadakal

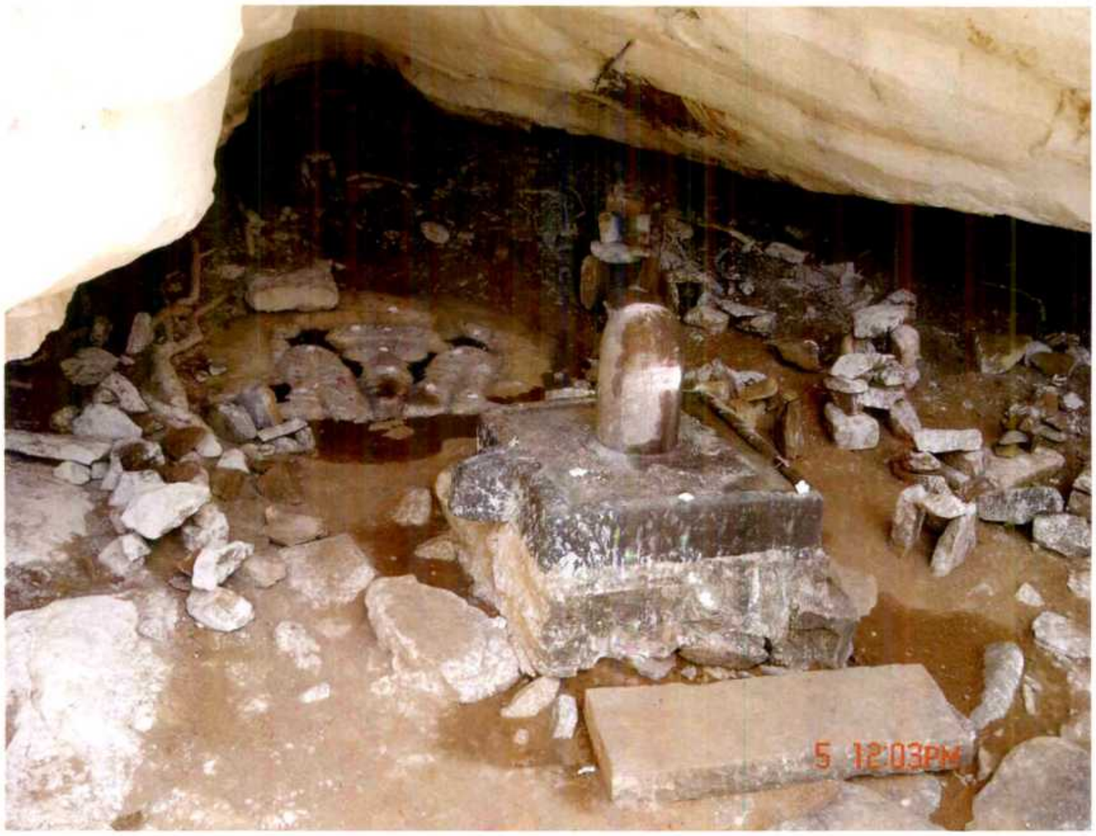

Fig. 3 Rock shelter with image of lajja-gauri at Siddhanakolla

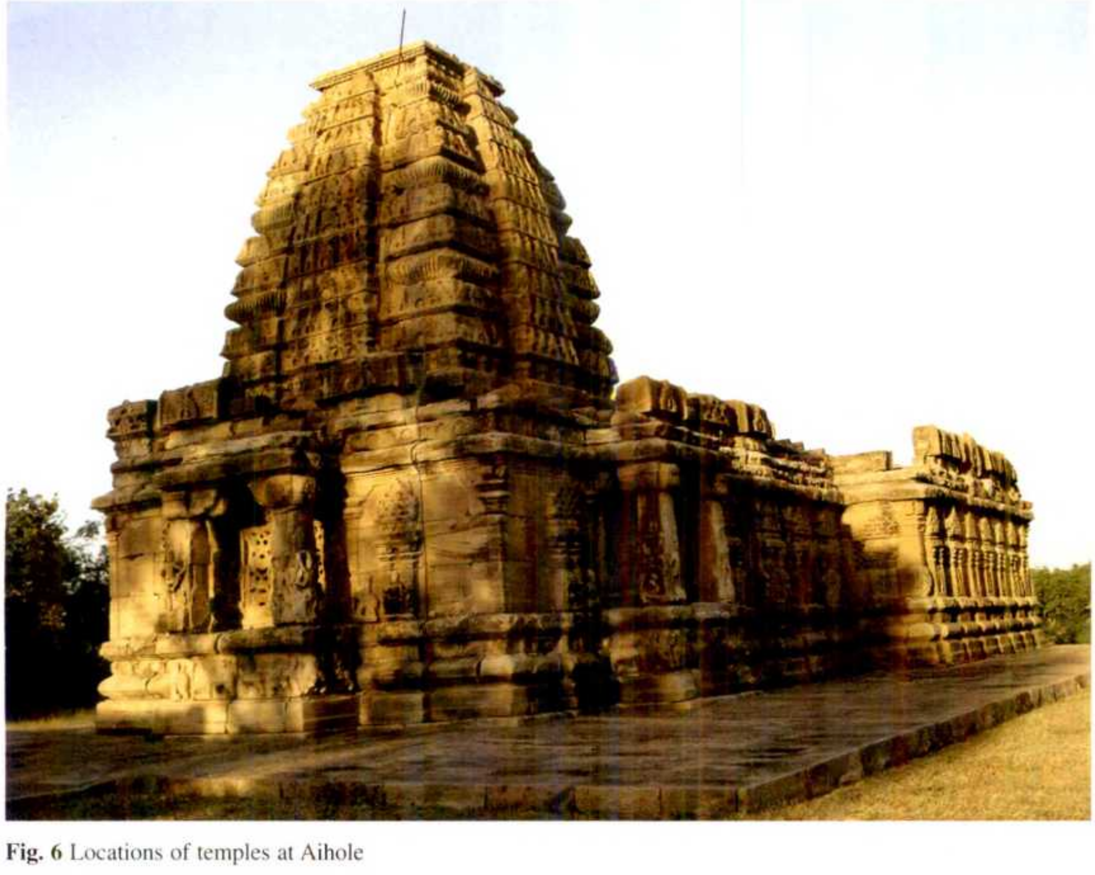

Fig. 6 Locations of temples at Aihole

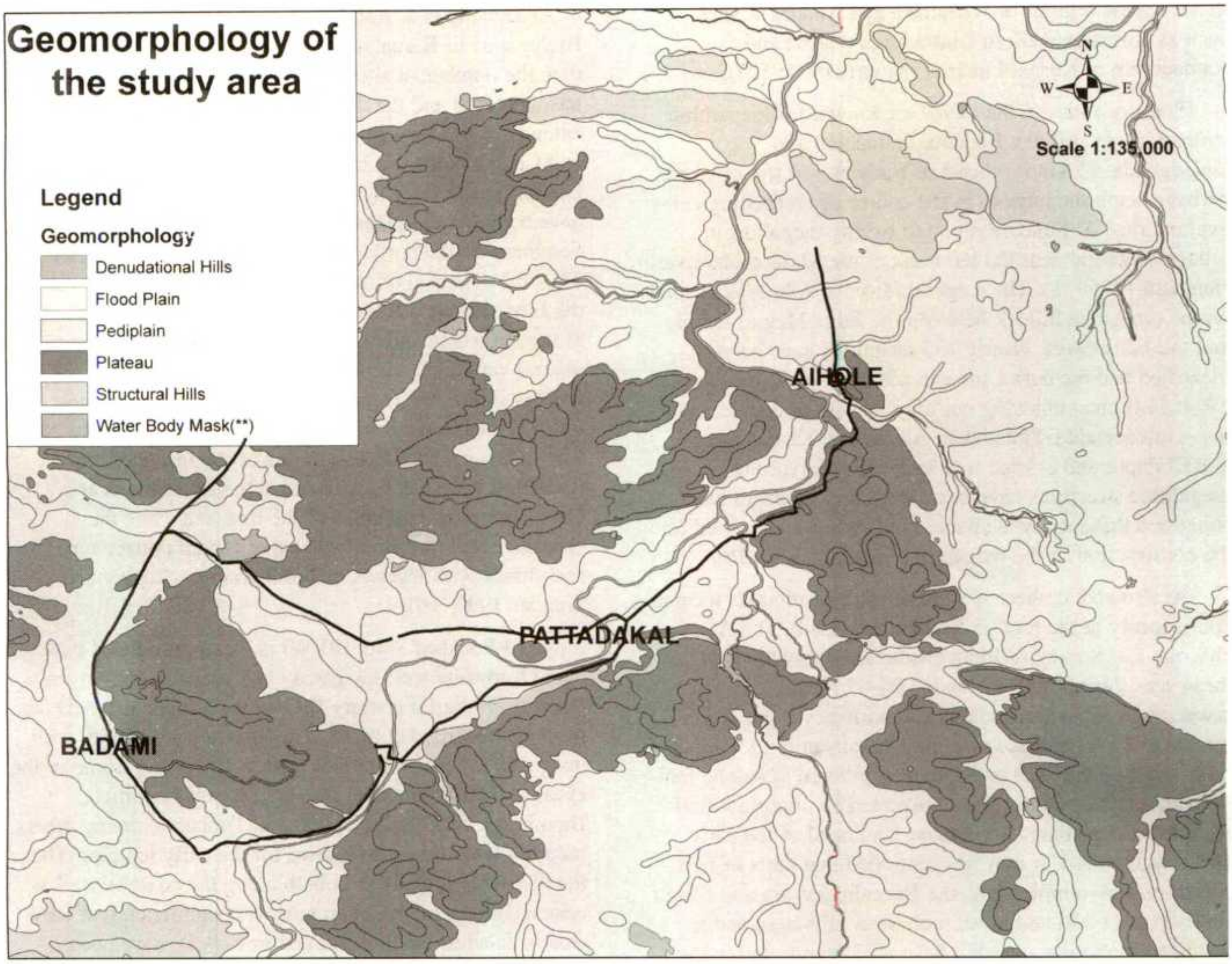

Fig. 2 Geomorphology of the study area

There is evidence for division of space between human activity, such as places for production of tools and the use of sandstone ridges and shelters for prehistoric rock paintings. The hill at Hiregudda, six km west of Aihole is rich in rock paintings and at least four sites with rock art are known around Badami (IAR 1975-76: 21). Paintings in black within a dull white border of animals, such as dog, a bird with long thin legs and ghost-like figures in black probably belong to the Upper Palaeolithic period, while an elaborate picture on lime representing three figures approaching a seated figure dates to the Early Chalukya period.

Agricultural village life in peninsular India and especially the Krishna basin dates to the third-second millennium B.C. Recent archaeobotanical studies based on an analysis of archaeologically preserved plant remains from Neolithic sites have shown the importance of pulses, such as horsegram or *kulthi*, green gram or *mung*, black gram or *urad*, pigeon pea or *arhar* and hyacinth bean or *sem* in the region. Two millet grasses recovered from across the region are brown top millet (*Brachiaria ramosa*) and bristly foxtail millet (*Setaria verticillata*), while there is also evidence for the cultivation of sorghum, wheat and barley. One fruit, which is widely preserved and recovered archaeologically, is *Ziziphus* sp. (probably *Z. jujuba*) the jujube fruit (Korisettar 2004: 162-84).

Megalithic monuments constructed of large slabs of sandstone often with sepulchral associations are conspicuous features of the landscape of the Malaprabha valley. It is significant that in the second millennium B.C. two major river basins, viz. the river Krishna and its tributaries the Bhima, Malaprabha and the Tungabhadra as well as the Kaveri further south show the highest concentration of Megalithic sites (Moorti 1994: 12). Though dates for individual sites are not available, the general time-span for the Iron Age and its associated megaliths covers a period from the beginning of the first millennium B.C. to the end of the third century A.D. A survey of the available radiocarbon dates indicates that the earliest megalithic burials date around 15th-14th century B.C. and were constructed in the upland regions of Karnataka and Andhra at sites such as Kumaranahalli in Chitradurga district and Ramapuram in Kurnool district (Moorti 1994: 123).

Four localities in the valley are known for megalithic structures, viz. Aihole, Badami, Pattadakal and Guledgudda, 25 km northeast of Badami – of these Aihole perhaps being the largest. In the course of archaeological explorations, A. Sundara reported twenty megaliths in village Akkargal near the left bank of the Malaprabha river (Sundara 1975: 31). The megalithic site at Aihole is located on the sandstone hillock between the Jaina Meguti temple and the Jaina caves. Nearly 133 megaliths have been identified and the burial site extends over 21.43 ha (Moorti 1994: 114) encompassing not only the site of Aihole, but also Guledagudda, Pattadakal, Akkaragal, Khayddigere and Chilapur and at least four architectural types of megalithic structures have been identified. Sundara has suggested that locally available sandstone was quarried for the construction of the megaliths (Sundara 1975: 36).

At Pattadakal, there is a cluster of four mounds located contiguously at the foot of Bachanigudda hill. The Archaeological Survey of India conducted excavations at these sites during 2003-04 and 2004-05 (http://www.asi.nic.in/writereaddata/sublinkimages). The lower terrace yielded evidence of a pre-Chalukyan brick temple with a cell on the west and a sixteen-pillared *mandapa* hall with an entrance platform on the east. The important finds included a sandstone *caturmukha* Siva head of the early Chalukyan period. It may be mentioned that parts of two eighth century temples, viz. the Baccalingesvara and Durga survive on the hill and loose sculptures of Natesa and a damaged Mahisasuramardini have also been found in the vicinity (Meister and Dhaky 1986: 93, 103).

The middle terrace revealed Iron Age Megalithic habitation at the depth of 1.15 m, which included well-preserved floors. This phase was characterized by Black-and-Red ware and Black Burnished ware and the excavation for the first time provided evidence for Megalithic habitation in this region. The upper terrace yielded a deposit consisting of roads, rammed floor, fire places with ash-pits, smelting activity area and dumping area of waste products belonging to early historic period. The antiquities included lead and copper coins of the Maharathis and the Satavahanas (these coins were recovered from the floor levels), beads of semi-precious stones and glass, iron and copper alloy implements. The pottery types included Russet Coated ware, Rouletted ware and Red Polished ware – all of which have been found in the subcontinent and provide indications of routes in the early centuries of the Christian era (Ray 1994: Chapter II).

In the 1950s only a few sites were known to have yielded Rouletted ware a fine textured pottery with rouletted decoration on the base dated from 2nd-1st century B.C. to 2nd century A.D. These included the sites of Arikamedu near Pondicherry, Chandravalli and Brahmagiri in Karnataka and Amaravati in Andhra. Since then the number of sites yielding Rouletted Ware shards has increased and the distribution map of the Ware now extends from Mahasthangarh (Alam and Salles 2001: 357) and Chandraketugarh in Bengal to Tissamaharama in Sri Lanka. Across the Bay of Bengal Rouletted Ware shards have been found at Buni culture sites in north Java, Sembiran on the north coast of Bali and at sites in Vietnam. Thus the dispersal of the Rouletted ware is primarily along the Bay of Bengal littoral in South Asia and across the sea at sites in island and mainland Southeast Asia. There are several variations within the Rouletted ware fabric, but what is significant is that though it does occur at some interior sites in peninsular India, its distribution has a clear Bay of Bengal focus, though one of the forms of the Rouletted ware has been found in the excavations at Berenike on the east coast of the Red Sea. Here the ceramic occurs together with other Indian pottery types and shards with legends in Tamil-Brahmi (Begley and Tomber 1999: 161-4).

Red Polished Ware (RPW) is locally produced pottery made from fine well-levigated clay, which occurs in strata dated from the 1st century B.C. to the 5th century A.D. and has been recorded at more than 400 sites in Gujarat, with up to 160 stylistic variations (Orton 1992: 46). Some of the excavated RPW sites are Dwarka, Somnath, Amreli, Devnimori, Shamlaji, Nagara, and Timbarva among others, many of which are also known for the early temples. Thus the distribution of RPW is both along the coast as well as centres further inland. It is, however, significant that RPW shards dated to the first five centuries A.D. have been found at archaeological sites around the Persian Gulf (Ray 2003: Chapter VIII). The presence of these wares at Bachanigudda provide evidence of significant links of the Malaprabha valley with sites along the east coast, the western Deccan, as well as with centres to the south-west in the early centuries of the Christian era.

These early links continued in the later centuries and are perhaps consolidated in guilds, such as that of the Ayyavole as reflected in the 8th century record from the Lad Khan temple at Aihole, which refers to:

> *The grant given to the Five Hundred who constituted the great body of Caturvedins (mahacaturvidya samudayam ai-nuruvarkam): a dharana at the ceremony of feeding a child with boiled rice, and at the festival held when the first signs of life are perceived in the foetus; and at the ceremony of tonsure. A gadyana at the ceremony of investiture with the sacred thread and at the rites performed when the religious student returns home after completing his studies. Two gadyanas at marriage and at the ceremony performed on the first sign of conception and at the celebration of an animal sacrifice. Three gadyanas*

> *at the celebration of the caturmasya sacrifices and five gadyanas at the celebration of the agnistoma sacrifice (Fleet 1879: 287-8).*

While this particular Kannada inscription refers merely to the *mahajanas* as administrators of the *agrahara,* another epigraph on a beam of the Gaudargudi temple at Aihole provides evidence of the *mahajanas* collaborating with other local groups, such as the eight *nagaras* and the 120 *Uralis* to make a grant to the goddess Durgabhagavati who later became the patron deity of the Ayyavole guild (Abraham 1988: 43). It is a 12th century inscription engraved on the walls of Carantimatha, Aihole that finally confirms the common identity of the two groups when it refers to a Jain merchant as the son of the five hundred svamis of Ayyavole (Abraham 1988: 44), thus emphasising the commercial nature of the settlement at Aihole.

In addition to trading linkages the agrarian base of the region continued to be an important resource, though detailed information on the nature of crops and the yield is absent. There are nevertheless references to donation of land and villages, for example, 25 *nivartanas* of land in the vicinity of Badami were granted to a Vedic brahmana (Fleet 1877: 72-5). The pillar inscription from Mahakuta refers to the grant of ten villages to supplement the property of the temple. The record of Pulakesin II from the Jain temple at Meguti hill mentions several villages that were gifted to the temple for its upkeep. Interestingly it mentions several types of settlements, such as village, hamlet, town etc. thereby indicating the complex settlement pattern that had emerged around the 7th century A.D. (Fleet 1879: 237-45). At other times, donations took the form of commodities, such as oil. A Kannada inscription from Huchhcimalli gudi of the period of king Vijayaditya records the grant of oil to one who was evidently a priest of his temple and is dated to Saka era 630 (Fleet 1879: 284-5). Thus by the 7th-8th centuries A.D. the early trading contacts had been consolidated and established on a firm footing, while at the same time the agrarian resource base had been expanded.

Archaeology of Ritual Space and the Cult of Lajja Gauri

Of all the archaeological indicators, perhaps the recognition of ritual and cult centres is the most difficult. Belief systems when expressed in terms of material culture are generally not separated from other actions of daily life and are difficult to differentiate, such as the distinction between simple feasting or dance and ritual activity is not always easy. Ritual, for example, may take place in a spot with natural association, such as a cave; or it may take place in a special structure such as a temple; and special devices may be associated with it like an altar, lamp or ritual vessels. Similarly, worship may involve prayer and special devices such as dance or music; sacrifice of animals; food and drink or other votive objects. Of course not all of these criteria would occur together at an archaeological site. Besides even if some of these can be identified in a particular case their association with a cult would only be conclusive when these occur at more than one site.

Evidence for ritual use of some of the rock-art sites comes from the prominent landmark of Hiregudda Hill, six km west of Aihole, where hundreds of petroglyphs are to be found along a dolerite cliff. Though some of the rock art is fairly recent, much of it dates back to the Neolithic period and depictions of cattle are common, along with those of human beings. Other images include elephants, tigers, birds, wheeled carts and footprints. Amidst the petroglyphs at this site are also round, polished grooves that emit musical ringing tones when struck with granite stones, as demonstrated to the archaeologists by a local informant, who referred to the inscribed boulders as "musical stones" (Boivin 2004).

The earliest stone image of a headless female figure termed lajja gauri was discovered in 1881 at Mahakuta near Badami (Fleet 1881: no. xciv, 103) and since then the chronology and number of images found has increased substantially. Various theories have been formulated regarding the identity of the image ranging from the Vedic references to Aditi uttanapad (Kramrisch 1956) to goddess with prehistoric beginnings (Sankalia 1978; Nath 1990). Marshall identified the lotus-headed terracotta figure from Bhita as Prithvi or Earth goddess and compared it with a motif on a Harappan seal (Marshall 1915: 75). After a four-fold categorisation of the more than one hundred images dated between 3rd-4th centuries and 7th-8th centuries A.D., Janssen concludes that this was, in all probability, a fertility cult, which originated from the worship of a supine image, especially during childbirth (Janssen 1993: 457-72). What is significant is the popularity of the form both in time and space across South and Southeast Asia and hence the image can no longer be categorised as a folk or regional deity (Sankalia 1960).

Several aspects of the worship of lajja gauri are significant. The first is that shrines dedicated to lajja gauri are known from archaeological excavations, though there is no uniformity in their nature and form. For example there is evidence of a structural shrine at Padri in the Talaja tahsil of Bhavnagar district of Gujarat hardly 2 km from the Gulf of Cambay, while elsewhere the image is found in rock-shelters. The only structure uncovered partially in the central part of the site comprised of stone construction, roughly rectangular on plan with rounded corners and with a hardened floor of alternate layers of clay and gravel. On the southern side of this stone enclosure were two compact floors with post-holes along the periphery suggesting some sort of a superstructure. There was no evidence of cooking or storage facilities on these floors indicating thereby non-domestic functions. Two terracotta plaques of lajja gauri were found on the floor of the structure, while a square slate plaque with the image of lajja gauri was a surface find. Other images included sandstone figures of Ganesa and Visnu (Shinde 1994: 481-5).

In addition to shrines, lajja gauri images also occur in natural rock-shelters as at Siddhanakolla 2 km from the village on the Pattadakal – Aihole road and at B.N. Jallihala, 17 km from Badami and 2 km off the Mahakuta – Pattadakal road, though the nature of the rock shelter is much altered at present (Fig. 3). The rock-shelter at Siddhanakolla has a natural trough in front, which collects and stores rain water and the lajja gauri image lying on its back is carved inside the rock-shelter, while two temples, i.e. Sangameshwar and Siddheshwar of the Chalukya-Rashtrakuta period are located nearby. The site continues to be in worship as an annual fair is held at the time of Sankranti when devotees come in large numbers and a modern temple has been built at the site.

About 50 km west of Badami is Yellamma-gudi, associated with the fertility goddess Yellamma or Ellama at Saundatti, a major centre for annual pilgrimage. The temple is situated on a hill, near megalithic tombs and archaeological evidence shows that the Yellamma temple precincts at Saundatti go back to mid 8th to mid 11th centuries A.D. An 8th century recumbent granite image from the Sangamesvara temple at Kudavelli now in the Alampur Museum (no. 52) provides further evidence of the rituals involved in the worship of the goddess. The raised rim of the stone slab and the pranâla or passage for water indicates ritual bathing of the image.

Can lajja gauri be described as a village goddess? Inscriptional evidence indicates that royalty also provided patronage to the deity. A fourth century inscribed marble image of lajja gauri was found in 1940 on the north slope of Nagarjunakonda hill at the edge of a pillared hall of a temple. The one line Prakrit inscription does not name the deity, but records that queen Mahadevi Cantamula, wife of maharaja Ehuvula Camtamula whose husband and children were alive, donated it (Narasimhaswami 1951-52: 137-9). King Vinayaditya (mid 7th century A.D) is said to have started the practice of building lajja-gauri shrines in order to propitiate the fertility goddess so as to ensure a regular supply of soldiers to the army (Bolon 1992: 32).

In addition to images, small plaques (5 x 4 cm) provided with perforations at the top meant for suspension were also found and were perhaps worn as charms or amulets. Two of these were found at Chandraketugarh in eastern India and have been dated on stylistic grounds to the first century B.C. to second century A.D. These are now in the Museum of West Bengal Directorate of Archaeology and bear accession numbers 04-450 and 04-11 (Roy Chowdhury 1999: 293-6). Nearly thirty lajja gauri images are in the site museum at Ter (Janssen 1993: 463) also known for its structural temple (*Archaeological Survey of India – Annual Report 1902-3*: 196), while others were excavated from sites such as Bhokardan. Thus while the spatial spread of lajja gauri worship is extensive ranging from Gujarat to Bengal and covering the entire Deccan the chronological span starts in the early centuries of the Christian era and continues into the present.

Nevertheless the concentration of lajja gauri sculptures in the Deccan is striking and they are found at almost every major temple site of 7th-8th centuries, often with saptamatrka images. Here the deity is depicted with a lotus head, with both arms raised and holding lotus buds. In addition to the Siddhanakolla examples from Malaprabha valley, images are known from Mahakuta, Aihole (Galaganatha), B.N. Jallihala and Naganatha, the last now displayed at the Badami site museum. Eight sandstone sculptures were found in Andhra between the temple sites of Alampur and Srisailam dated to the early Chalukya period.

A new development around the 6th-7th centuries was the anthropomorphization of the lajja gauri image and the replacement of the lotus with a female head, though the posture continued to be the same (Janssen 1993: 468). Sixth-seventh century lajja gauri figurines have been reported from a number of sites in Gujarat such as Kanad and Variav in Surat, Kavi in Bharuch, Pavti Jetpur in Baroda, Tarsang and Bavaka in Panchmahal, Valabhipur and Gagdhali in Bhavnagar, Amreli in Amreli district, Dhanak in Rajkot and Sathal in Ahmedabad (Sonawane 1977-78: 27-35). Two 10 x 12 cm lajja gauri plaques were found at Nuapada in Orissa and dated to the 8th century A.D., though similar representations are also found among the Maria tribe of Bastar. These have been found both near Hindu temples as well as in Buddhist contexts cave 21 Ellora and the worship of the goddess continued into the 17th century as evident from sculptural depictions on temples at Hampi in the Vijayanagara kingdom (Verghese 2000: chapter 8).

The question remains, was the worship of lajja gauri brahmanised and assimilated into the identity of Sri and Parvati as often suggested (Bolon 1992: 70; Elgood 2004: 336). This notion of integration into a Brahmanical mould is countered by Sankalia who argues that images of the goddess in birth-giving posture though with heads continued to be made until recently (1960: 121). Among the Warlis, the naked, headless goddess in the birth-giving posture is referred to as Palghata and her image is drawn with rice flour on the walls of the house where a marriage is taking place (Verghese 2000: 170, footnote 45). Such figures with heads continue to be made at Kampong and Sangâ, Middle and West Celebes and Palau and Java (Sankalia 1960: 121).

Access to Groundwater and the Demarcation of a Territorial Base

It is then evident that in the 7th-8th centuries, the Malaprabha valley acquired a cultural identity that it retained for at least the next four to five hundred years (Fig. 4). This demarcation of space included not only political centres such as Badami, but also centres of pilgrimage like Mahakuta and places like Pattadakal where royalty established temples. In addition there were a diverse range of sites of worship and settlement that came to be linked through the temples. This section attempts to define this newly emerging nuclear area in terms of the utilisation of groundwater resources and the location of shrines in close proximity to underground springs and river valleys.

Badami is nearly 4.5 km from the Malaprabha river at the outlet between two rocky hills on its north and south sides. The inscription of Pulakesin, the founder of the Calukyan dynasty, occurs on the fortification and is dated A.D. 543/4. A century later around A.D. 642, the Pallavas conquered Badami and it was only later under Vikramaditya I that Calukya rule was re-established in A.D. 654/5 in the Deccan – Andhra – Telengana regions. The nine rock-cut temples date from the third quarter of the 6th century and the cutting of cave III at Badami marks the culmination of this phase in A.D. 578 (Tartakov 1980: 70).

A dam to the east of the present town between the bases of the hills forms a large tank, which at present provides the supply of water to the town. All along the north side of the Bhutanatha tank are two groups of temples and two rock-cut bas-reliefs, while the hill behind them is a ruined fort, taken by a British detachment under Sir Thomas Munro in 1818. At the east end of the tank, there is the temple of the god Bhutanatha and there are some short damaged inscriptions on the columns of the *mandapa*. The only one of importance is a 9th-10th century inscription on the outside of one of the stones in the north wall of the temple, which records the gift of eight *mattars* of cultivable land to the venerable Sridharabhutesvara (Fleet 1881: 62). On the way to the northern fort, near the figure of Hanuman cut on the rock an inscription reads: ...(of the village of) Mudugal, who was the worshipper of the holy feet which are like lotuses of the goddess Kalika and of the god Sri Kamathesvara (Fleet 1881: 62).

Located midway in the enclosed terrain of the Malaprabha valley is Pattadakal and one of the first shrines to be built at Pattadakal was that of Papanatha (Fig. 5). It seems that the Papanatha temple grew from a small two-unit temple into the grand size it now has through expansion, remodelling and adaptation (Bolon 1987: 229-232). An outer mandapa was added to the west of the conventional one and together with the inner one added to its present dimensions. The Virupaksa, on the other hand, is the largest of all Calukya temples and consists of a *sandhara vimana* with a large *gudhamandapa* or closed hall with three porches and a *nandimandapa* (Meister and Dhaky 1986: 78). The Lakshmi pillar inscription at Pattadakal dated 745 A.D. refers to three stone temples sponsored by royalty (Bolon 1988: 62).

In contrast to Pattadakal where the cluster of temples lies along the river, most of the shrines at Mahakuta are located within the confines of the walled compound around the tank known as Visnu Puskarini. Mahakuta contains remains of nearly thirty temples, twenty-two of these being attributed to the Early Calukya period. The *dharma-jayastambha*, which Mangalesa claims to have erected is a free-standing pillar similar to the one in the Ravanaphadi complex at Aihole. The message on the pillar records Mangalesa's victory over Buddha raja, a Kalacuri ruler and his subsequent gift of ten villages to the god Mahakutesvara natha made in association with and in the presence of Durlabhadevi, the wife of Pulakesi I, his father and possibly the mother of Kirtivarma, his elder brother, whom he followed on the Calukya throne. It refers to a god already established at the site and previously patronised by Kirtivarma and includes images substantial enough to be taken out in procession (Tartakov 1985: 139-40).

Local tradition as recorded in the *Mahakuta Mahatmya* narrates that this was the scene of destruction of the demon brothers Vatapi and Ilvala by the saint Agastya. Near the steps on the west side of the tank there stands a linga-shrine in the water with a *pancamukhalinga*, while in the courtyard are a number of small linga temples and a cell with an image of Lajja-Gauri. The only two temples of any size in the courtyard are those of Mallikarjuna and Mahakutesvara and it is the latter that has three inscriptions. The first is in the porch of the temple and belongs to the time of the Chalukya king Vijayaditya. It records that one of his concubines *prana-vallabha* Vinapoti bestowed the entire gift of a *hiranyagarbha* and having made a pedestal for the god with rubies and having set up its silver umbrella, gave a field called Mangalulle (of the measure of) eight hundred.

The second inscription is on the front or north face of another pillar in the porch. It appears that the pillar was a votive offering of a certain Puttimaninage and the inscription mentions a certain Mahasamanta named Ereve, who seems to have issued some edict regarding the pillar or the temple to the guild of the one thousand nine hundred and sixty-six. The third inscription is on the east face of the pillar inside the same temple and records a grant of three rice fields at the village of Nandikesvara made to the temple by the Mahasamanta Bappuvarasa in Saka 856 (A.D. 934-5) when he visited it (Fleet 1881: 102-104). These inscriptions not only highlight the role of the royalty in patronising the religious structures but also more significantly link the shrines to the larger social world of agrarian villages and trading networks and guilds. While the tank at Mahakuta is praised in the *Puranas* and the *Mahatmyas*, water bodies at other sites, especially at

Badami become crucial sources of water for the sustenance of the villages and communities located in the area. It is these inter-linkages between varied spaces such as religious, social and political that are highlighted when analysed within the larger context of the Malaprabha valley and satellite images provide significant tools and techniques for an appreciation of the spatial intersections in history and archaeology.

The location of water-bodies and temples indicates the beginnings of temple construction on Meguti hill and its extension the Ravalaphadi caves, as well as in the centre of the village at Lad Khan where wells were dug for the purpose of providing a source of water. The natural source, viz. the Malaprabha river does not appear to have been a favoured early core area as only one small temple in the Ramalinga group near the Malaprabha river, viz. the Puspabhadra temple to the south of the village of Aihole dedicated to the goddess Sri in the form of a lotus and oriented to the west to face the river is dated to the first phase of construction (Meister and Dhaky 1986: 64).

A characteristic feature of early religious architecture at Aihole is its diversity in terms of religious affiliation and this is evident both from the shrines at Siddhanakolla and the earliest constructions on Meguti hill (Fig. 6). The site of Siddhanakolla has already been discussed and included a rock-shelter with a natural trough in front, which collects and stores water. Another rock shelter site is that of Bhadranayakana Jalihal, 3 kiloms from Pattadakal, which also has a spring and a water-body in front. Inside the natural cavern are several early Chalukya sculptures, such as a Saptamatrka set carved in the wall, Ganesa, Siva, Parvati, Brahma, Visnu, Nandi, Vasuki, Nagaraja, Lajja Gauri, etc, while in front of the cave are eleven small Chalukyan temples.

> *Nine have an open porch and a vimana with tiered pyramidal sculptures. One enshrines a standing Siva and Parvati with Nandi in a style datable to A.D. 720. The temples have no exterior niches. One of the temples is interesting for its inscription by either its donor or builder. It is referred to as a funerary shrine or karandaka (casket) bearing shrine of Vikramaditya II who ruled from A.D. 733-45. Nearby carved on a boulder in a vertical rectangle that looks like a hero-stone are figures of a seated king flanked by female cauri-bearers (Meister and Dhaky 1986: 92).*

Several phases of temple construction have been identified at Aihole starting from the late 6th century, which continued until the 12th century with several renovations and additions. In the Durga temple, for example, a step-well and a shrine were added in the later Kalyani Chalukya period (A.D. 973-1198), while Konti-guddi group received additional structures in the Rashtrakuta period (A.D. 757-973). No stone temples were, however, created at Aihole after the fall of the Kalyani Chalukyas at the end of the 12th century.

In the final analysis it is evident that a spatial analysis of religious architecture emphasises continued sanctity of several locations from the prehistoric period onwards, as a result of which sites such as Badami or Aihole retain their religious position for a very long period. Others such as Mahakuta owe their religious significance to myths associated with them and repeated in the *Puranas* and the *Mahatmyas*. Secondly, the diverse nature of religious architecture is obvious as well as the coexistence of Buddhist, Jain and Hindu shrines along with those of local cults. Of particular relevance is the reinvention of rock-shelters within the changed landscape of Hindu shrines and networks of pilgrimage and the location of lajja gauri shrines in close proximity to temples as at Siddhanakolla. The site continues to be in worship as an annual fair is held at the time of Sankranti when devotees come in large numbers and a modern temple has been built at the site. A final realisation evident from the archaeological record is the close association between religious architecture and the community. This interaction is best exemplified by shared agrarian spaces as indicated by the presence of water systems, for example, the tanks at Badami and Mahakuta and the large number of stepped wells at Aihole.

Thus, archaeological data highlights the multiple layering and survivals of religious sites – themes, which tend to get homogenised and appear linear in any undue emphasis on textual accounts. Historians have tended to discuss religious expansion in terms of acculturation and Sanskritisation suggesting the integration of local cults and deities. The above survey indicates that this may perhaps be a simplification of a complex and dynamic process that involved sharing and negotiation rather than hegemony and integration. This sharing and negotiation was a bilateral process founded on the basic relevance of religious sites and structures to the community that maintained and supported them.

Acknowledgement

The authors gratefully acknowledge a grant from the Jawaharlal Nehru University under the UPOE (University with Potential of Excellence) Scheme that enabled field-work and purchase of satellite images.

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R. Balasubramaniam, *Man and Environment* XXXII(1): 102-107 [2006].
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On the Steeling of Iron and the Second Urbanization of Indian Subcontinent

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Abstract

The advent of iron technology in the Indian sub-continent and its impact on urbanization in the Ganga plains has been discussed from the viewpoint of development in iron technology, particularly deliberate caruburization. The current state of art on the prevalent viewpoints on the connection between iron and the second urbanization has been first reviewed. Archaeological and material evidences have been provided to show that the discovery of steel (specifically the deliberate addition of carbon in iron) played a major role in large scale clearing of forests in the Ganga plains that spurred agricultural, urban and economic growth in the Indian sub-continent in the period 500 to 300 B.C. The technical benefits of steel when compared with bronze have been briefly explained in order to appreciate the impact of steeling of iron on society and social formation.

Introduction

The advent of iron technology in the Indian sub-continent and its impact on the second urbanization, (i.e. of the Ganga plains), has been a subject of great debate for well over half a century. There is ample evidence to associate the first urbanization (Harappan civilization) with copper/ bronze technology.

The manufacture and use of iron began in the Indian sub-continent around the middle of second millennium B.C. It is further established that the origin of iron technology was a product of indigenous development. However, the impact of iron technology on society in the Indian subcontinent, especially on the social and economic spheres, is still a hotly debated topic, primarily because of intricate nuances associated with this problem of connecting iron technology and social change. The focus of attention has been the important direct and indirect connection of iron technology and plough share technology. The impact of this connection as well as that of flourishing plough share technology on society needs critical review. The questions to which answers are sought are how a society of surplus emerged once the dense jungles of the fertile Ganga plains were cleared and what was the role of iron technology in making this happen. It is very important to understand this because this is a very relevant and fundamental social and historical subject. The surplus in food production combined with the establishment of active trading networks appear to be the cause of several other important developments in early India like emergence of cities, germination of new religious thinking, increase in use of metallic coins, and formation of new state-societies.

The concept of iron technology diffusing into India from external sources is almost invalid in light of recent research findings. Early ideas about the Aryan-migration theory and the introduction of iron technology into India from the West have now been proved to be incorrect. For example, Pleiner (1971) proposed that the so-called Aryans had no iron production until the second half of the first millennium B.C., and that there was no iron export to the West from the area of the Aryans, whom he assumed to be "the Sanskrit speaking people." However, there are firm dates for the advent of iron in the Indian sub-continent before this period. The independent origin of iron in the Indian sub-continent has been convincingly argued by Chakrabarti (1992) and Tripathi (2001). Agrawal and Kharakwal (2002) have compiled all radiocarbon dates of excavated iron manufacturing sites in the Indian sub-continent. The earliest available date at present is from Raja-Nala-Ka-Tila in Uttar Pradesh (3050±90 BP).

An analysis of Pleiner's archaeological data shows a two-stage development in the application of iron in India during the period of second urbanization. The first stage is identified with a phase where iron was not used for common purposes (800-500 B.C.) (since material repertoire from archaeological excavations consists mainly of tools such as chisels, adzes, axes, sickles and knives) and the second stage with the phase when it entered the life of the masses (500-300 B.C.) (material finds include household items like utensils, vessels, pans and spoons in addition to working implements).

The approach to addressing the problem of the impact of iron technology on important social changes, especially in the initial stages of advent of iron technology in the

Received : 20-9-2006
Revised : 11-12-2006
Accepted : 5-2-2007

Indian subcontinent, has been well laid out in a recent elaborate essay by Sahu (2006). After reviewing the existing different views on the impact of advent of iron technology on second urbanization, we shall suggest a new way to look at this age-old problem. It must be cautioned, at the outset, that iron technology alone need not be the sole reason for surplus and that the society must be ready for it socially and culturally. For example, Ghosh (1973) proposed other schemes by which the dense forests of the Ganga plain could have been cleared – using copper-bronze tools and by burning.

State of Current Understanding

Several causes have been proposed by eminent scholars for the second urbanization of the Indian subcontinent. The important landmarks in the evolving debate can be understood starting with D.D. Kosambi's (1952; 1963) proposal as the origin. Kosambi (1952), proposed for the first time in 1952, a connection between iron technology and the clearance of the forests of Ganga plains. This initiated the debate on impact of iron technology on society. Sharma (1968) argued that iron transformed both economy and society around 700 B.C., and he has related the advent of iron technology and its impact in creation of active trading society on the rise of "protestant" movements like Buddhism. Sharma further argued that iron acted as a catalyst that transformed material life in the Ganga plains. He co-related the rise in craft production using other raw materials with the remarkable growth in the use of iron tools from around 500 B.C. (Sharma 1974; 1993). The impact of iron on surplus produce and the growth of cities, around the same time, have been argued by Agrawal (1967-68) from the perspective of its increasing abundance and cheapness compared to bronze.

Chakrabarti (1972-73) agreed with the slow-moving iron technology hypothesis of Ghosh (1973) by noting that there was no dramatic break seen in the cropping pattern and cultural aspects of the Chalcolithic and iron-using cultures and argued against any relationship between iron and the second urbanization noticed around 500 B.C. (Chakrabarti and Lahiri 1993-94). Ray (1975-76) analysed available archaeological data and argued that large scale felling of trees and tilling of lands was unsupported by the discovered tools even in the early NBPW period. He concluded that iron might have impacted society in a very big manner from the Maurayan period onwards.

We must also realize that there are views that seriously question the connection between iron technology and second urbanization. In opposition to the view that iron technology was important in urbanization, Makkhan Lal (1986) concluded, based on subsistence requirement and land-use pattern and iron tool typology from the PGW and NBPW periods, the extensive tilling of agricultural land was not due to iron technology but to culmination of social, political and economic factors. There are some fallacies in his argument and these have been pointed out by Sahu (2006). Chakrabarti and Lahiri (1993-94), having noted the widespread availability of iron ore deposits in the Indian subcontinent, conclude that the advent of iron did not lead to a revolutionary growth in the protohistoric period. Ratnagar (2000) also critiqued the theory relating iron with surplus and state formation by noting that agricultural technology and productivity have been presented in an oversimplified manner in earlier arguments. She calls for a more sophisticated interpretation of available archaeological material. There are other scholars who do not assign a prominent role for iron technology in the second urbanization but attribute the resurgence of iron tools in the second urbanization period to the need for producing more crops (Erdosy 1985; Connigham 1995, Tiwari 2004). Thakur (1981), on the other hand, is less enthusiastic about impact of iron technology on agriculture, but agrees to its importance in urban growth.

The impact of advent of iron technology in regions other than the upper and middle Ganga plains has also been addressed by scholars. Sahi (1982, 1983) assessed the impact of iron technology in the Doab and concluded, based on iron objects discovered at several sites, that iron technology was used in the PGW period to clear forest lands on a large scale. The discovery of iron ores in Bihar in the succeeding NBPW stage certainly provided a great boost to human colonization of new lands.

Tripathi (2001) concluded that iron technology positively affected social and economic developments starting from the fifth century B.C. Her conclusions are based on careful analysis of metallurgical and archaeological data from the Black and Red Ware, PGW, NBPW and Sunga-Kushana periods. The impact of iron technology can also be noticed from the fact that farming was more productive in the early historic period without the introduction of any new crop (Varma 1990).

It is clear that the discernible changes in social formations from 500 B.C. onwards have its origin in both social and economic causes. There is a great need to take a closer look at the recently unearthed new evidences to understand this evolutionary process. There are several benefits from positive interaction between historians and archaeologists in order to relate the historians' concern for social and economic implications of iron technology with archaeologists' field explorations to unearth cultivation technology, crop patterns, irrigation methods, settlement history and material use. In this cycle of interaction, the positive contribution that may emanate from technical professionals is often overlooked. The interpretation of history of technology by historians and archaeologists will be greatly benefited by considering the viewpoints of technologists.

It is to be noted that the role of carburization of iron (i.e. the discovery of steel) has not been critically viewed in the literature. This aspect is crucial to the understanding of the second urbanization of India and forms the substance of this communication.

The Proposal

Significant technological developments in iron technology in the Indian subcontinent must be first understood before assessing its impact on society. The useful properties of iron are greatly affected by addition of small amounts of carbon. Technically, iron's containing small amounts of carbon (less than 2.2 wt %) are known as steels. Almost all archaeological reports state the finds as iron objects. How many of these objects are of steel is a very important factor in the urbanization question. The advent of deliberate carburization of iron is a very important technological development in the history of iron technology, especially in the Indian context, because the Indians later became very proficient in producing special steels of high carbon content (1.0-1.8 wt %) (called *wootz* steel), possessing a combination of useful properties like good toughness and the ability to maintain a sharp cutting edge. This subject of advent of carburization suffers due to lack of detailed technical (i.e. metallurgical) analysis of discovered iron objects. The connection between the discovery of carburization of iron and urbanization is immediate and obvious. With the discovery of carburization of iron (i.e. manufacture of steels), it would have been readily used for manufacture of tougher and sharper iron implements and tools. The earliest iron objects, that show firm metallurgical evidences of deliberate carburization, date from about 810 B.C. (Ghosh and Chattopadhyay 1982). It is therefore evident that steeling of iron (i.e. discovery of deliberate alloying of carbon to iron and its resultant technical benefits) played a crucial role in social formation and the second urbanization in India.

Evidence

Carburization was known to Indians quite early. Ghosh and Chattopadhyay (1982) have reported an iron sickle found at Barudih in Bihar dated to 810 B.C. It contained 0.35% C, 0.2% Si, 0.2%S, 0.5% P and 0.04% Mn. Metallographic examination has shown the presence of 40% pearlite phase and at some places tempered martensite at the sharp edge.

Hadfield (1912) has analysed several iron objects from Taxila and found them to contain 1.3 to 1.5% C. According to him, the main feature of these specimens, belonging to first and second century B.C., was their high carbon percentage, namely 1.23% in one of the samples. He found that a chisel showed distinct signs of carburization varying on the two faces "from saturation point (0.9 per cent) to about 0.2 per cent carbon on the outside edge." Hadfield further remarked that "the presence of martensite and hardenite suggests the important information that the chisel has been quenched." The hardness and microstructure of two other samples indicated the presence of high carbon but these samples did not show the presence of martensitic structure. Hadfiled concluded that he had never come across earlier any other specimen with such high carbon elsewhere and that the Indians in Taxila at this time made high carbon steel deliberately. One of the most famous metallurgists of modern times, Hadfiled, thus concludes, "the author believes this to be the first time there has been put up on record evidence of the art of cementation having been known 1500 to 2000 years ago, as shown by these specimens; probably therefore, such knowledge could be traced back still further."

Fuerbach (2002) agrees that there is evidence suggesting that *wootz* steel was produced at such an early time (300 B.C.) in India. Pliny (died 79 A.D.) wrote ... "But of all the varieties of iron the palm goes to the Seres with their fabrics and skins. The second prize goes to Parthian iron; and indeed no other kinds of iron are forged from pure metal, as all the rest have a softer alloy welded with them" (Pliny, XXXIV translated by Rackham, 1995: 143). The Seres are the Tamil Cheras of South India. The large number of Roman coins found in the Chera territory attests to the robust trade of the people of the Deccan and south India with the Romans. The Tamil Cheras are known to have been wootz steel producers from at least the 3rd century B.C. based on recent archeological finds (Rajan 1989-90 and 1990; Craddock 1998; Srinivasan and Griffiths 1997).

The present of *wootz* steel ingots received by Alexander, when he reached the western frontier of India, clearly attests to the mastery of the Indian blacksmiths in producing and processing high carbon steels. Quintus Curtius mentions that a present of steel cakes was made to Alexander of Macedonia (323 B.C.) by Porus, an Indian Chief, whose country he had invaded (Neogi 1914). This shows that the material was much valued and as Neogi (1914) comments, "we can hardly believe that a matter of about thirty pounds weight of steel would have been considered a present worthy of the acceptance of the conqueror of the world, had the manufacture of that substance been practiced by any of the nations of the West in the days of Alexander." Neogi also noted that there is no evidence to show that any of the nations of antiquity besides the Indians were acquainted with the art of making steel. He stated that the references to iron that occur in the Greek and Latin writers reveal their ignorance and not understanding. Although they frequently refer to the qualities of steel, they never refer to the method by which it was prepared from iron.

The exceptionally long and localized monopoly of the smelters of India in the production of *wootz* cakes from 400 B.C. has been appreciated (Panseri 1962). It is known that *Rasaratnasamuccaya's* (Kulkarni 1969) 'bluish black' *Kalayasa* (5.82), which had been mentioned much earlier in section 2.17.14 of Kautilya's *Arthasastra* (Sharma Sastry 1929), corresponds beautifully with the Damascus sword, and thus establishes India's primacy not only in *wootz* but also in finished steel.

Very few excavations of *wootz* production sites have been conducted in India. The few studies indicate crucibles dated to 250 B.C. in Tamil Nadu. The site at Kodumanal is dated to the 3rd century B.C. – 3rd century A.D. It is the earliest dated site containing crucibles that were used for *wootz* steel production (Rajan 1989-90 and 1990; Craddock 1998; Srinivasan and Griffiths 1997).

The Impact of Steeling of Iron

Let us take a look at the properties that evolve when carbon is added to steel. The most significant is the strength of the material. There is increase in strength of steel with increasing percentage of carbon. A useful property that can be readily co-related with strength is hardness. The variation of hardness as a function of carbon content in iron is shown in Fig. 1 (Metals Handbook 1990).

There are several other technical benefits of alloying carbon in iron. The most notable is the ability to produce a material with a wide range of strength (or hardness). When steels are heated to high temperature (above 725°C) and then cooled down, the mechanical properties that will be obtained is a function of the cooling rate employed. With higher cooling rates, higher strength is obtained. At an extremely high cooling rate, the phase called martensite forms and this is an extremely hard and brittle phase (notice the high hardness of martensite in Fig. 1). By proper quenching of steel (for example, the cutting edges) into water, it would be possible to obtain a very hard cutting edge. Additionally, by suitable tempering treatment (i.e. heating the quenched martensite structure in a lower temperature range of 200-400 °C), the toughness of steel is enhanced. Toughness can be defined as the property that results if a material is strong as well as ductile. Good toughness also indicates good resistance to impact loads, like that which is required during cutting operations. The tempering treatment produces tempered microstructures which are strong as well as ductile, thereby resulting in good toughness. The higher strengths obtainable with quenched and tempered structures when compared with simple air cooled structures in case of steels can be readily appreciated in Fig. 1. The above discussion clearly brings out the great technical benefits of steels and how the properties of steel could be successfully engineered by appropriate heat treatments. Therefore, there were several benefits in employing steels for a wide range of applications, once the benefits of steeling of iron were understood.

We had seen how strength could be imparted to iron with the deliberate addition of carbon and successfully manipulated by heat treatments. How does this compare with copper and bronze based cutting objects? In case of copper, hardness at the cutting edge is obtained either by cold working or by deliberate addition of some alloying elements like tin (Sn). The variation of hardness as a function of Sn content is shown in Fig. 2 (Cahn *et al.* 1996) for the case of undeformed and 50% deformed alloys. As expected, the deformed alloys exhibit higher hardness than the undeformed alloys. In both cases, there is increase in hardness with Sn addition. This is understandable based on the solid solution strengthening effect of Sn in copper. We may recollect here that copper alloys that contain tin are known as bronzes and those that contain zinc as the main alloying element are known as brasses. We notice that there is increase in hardness of copper with deliberate alloying with tin. However, what is

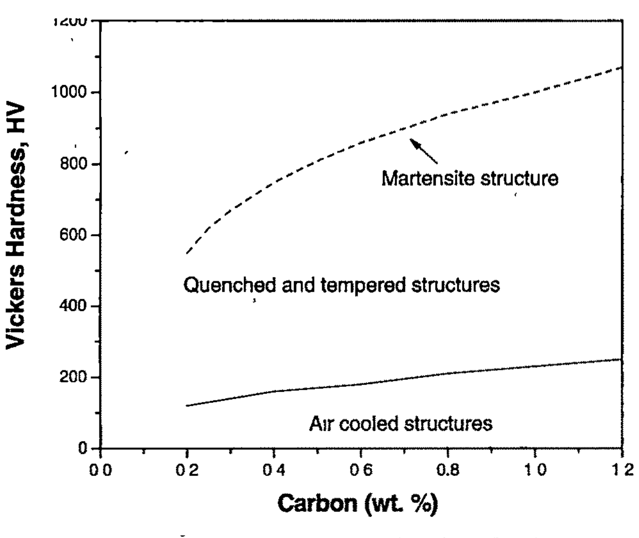

Fig. 1 Variation of hardness of steel as a function of carbon content and microstructure (Metals Handbook 1990)

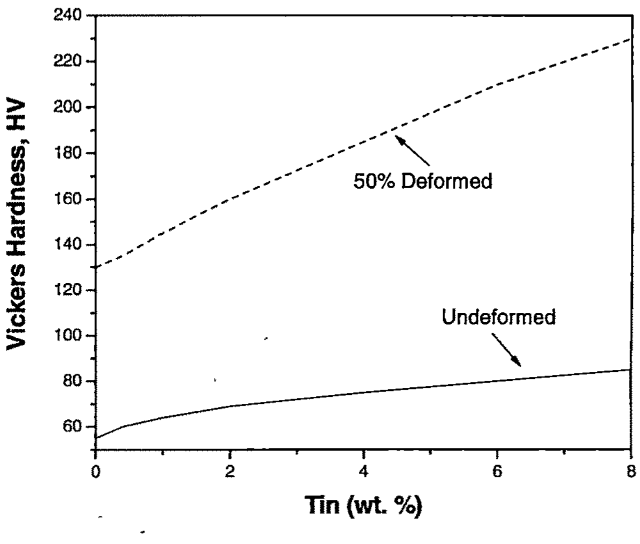

Fig. 2 Variation of hardness of undeformed and 50% deformed copper-tin alloys (Cahn *et al.* 1996)

significant to note is the level of strength (or hardness) that is achievable in the case of copper-tin alloys when compared to steels. On comparing Figs. 1 and 2, it is clearly evident that steels are harder (and stronger) compared to bronzes (and other copper alloys). Moreover, the great range of hardness obtainable in case of steels deserves notice (Fig. 1). Therefore, the advantages in using steels for cutting applications can be readily appreciated.

Evidences were provided earlier to show that the iron smiths of the second urbanization period had realized the importance of carbon on controlling the properties of iron. That they experimented with even higher carbon contents (like more than 1.0% C) is evident from the popularity of *wootz* steel through the ages (Feuerbach 2002).

It may be pertinent to note that at such high carbon contents, steel is normally brittle (i.e. it does not possess ductility and therefore is susceptible to failure under impact loads). The ancient Indian blacksmiths overcame this problem by careful thermomechanical treatments performed in a precise narrow intermediate range of temperature. By empirical experimentation, they discovered that by working the high carbon steel (*wootz* steel) in a particular intermediate temperature range 700-800 °C (i.e. in cherry red hot ~750 °C condition), they were able to tailor the microstructure of the high carbon steel which resulted in good ductility along with strength (Taleff *et al.* 2001; Verhoeven *et al.* 2001). This was the great mystery of the *wootz* steel which several eminent Europeans scientists, including Michael Faraday, so zealously tried to decipher in the early 19th century (Smith 1965). The experiments, that these European scientists conducted in order to unravel the mystery of the *wootz* steel, laid the foundation of modern alloy steel metallurgy. Therefore, this brief discussion further shows the importance of steeling of iron in the historical context.

Conclusion

The discovery of steel (specifically the deliberate addition of carbon in iron) played a major role in large scale clearing of forests in the Ganga plains that spurred agricultural, economic and urban growth in the Indian subcontinent in the period 500 to 300 B.C.

Epilogue

The available material evidences are not many. There certainly exists a lacuna in knowledge-base. Important connections in our understanding of the second urbanization of India are still missing. Archaeological finds of material objects have been generally utilized to interpret and understand social formations. However, there have been no detailed technical (i.e. metallurgical) studies of iron objects to support and validate the arguments, which are mostly based on interpretation of archaeological data alone. Interpretation (and re-interpretation) of archaeological data in the absence of detailed technical analysis of the discovered iron objects will always be subject to criticism. A large amount of iron objects has been unearthed in numerous archaeological excavations conducted in the subcontinent. Apart from reporting the typology of the discovered objects, their detailed metallurgical investigations of the objects are not conducted. It is not our purpose to examine what are the reasons for lack of technical studies but to emphasize the importance of detailed metallurgical analysis of select objects. The large corpus of iron objects needs a careful study by first mapping important pieces (based on their time period and location, by specifically choosing agricultural objects dateable to the transition between the PGW and NBPW periods, and originating from the middle Ganga plains) and conducting detailed metallurgical studies on these samples. Such a study will provide critical and crucial inputs to understanding the problem of the steeling of the iron on society in early India.

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L.S. Rao, *Man and Environment* XXXII(1): 108-109 [2007].
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A Note on Dancing Girl from Bhirrana, District Fatehabad, Haryana

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The famous bronze "Dancing Girl" from Mohenjodaro is justly known for its stance and workmanship. With its tilted head, flexed legs, right hand resting on the hip; and left suspended by its side, the bronze sculpture though nude enjoys a modest ornamentation with a necklace, wristlets and armlets. A statuette of 11 cm in height, it occupies a unique position in the sculptural art of the Mature Harappan period. A similar bronze statuette of an upright standing female, also from Mohenjo-daro, has been reported; but it is much corroded and looks crude so far as workmanship is concerned. E.J.H. Mackay thought that both the statuettes were the creations of a single craftsman (as quoted in Dhavalikar 1988: 13-21). So far, no parallel of the Dancing Girl, made in bronze or any other medium, was known. However, during recent excavations of a Harappan mound at Bhirrana (29° 33' N; 75° 33' E), District Fatehabad (Haryana) a caricature of a Dancing Girl engraved on a sturdy Red Ware sherd of the Mature Harappan period was found (Rao *et al.* 2004-05: 65). It is a highly stylized figure whose torso resembles that of an hour – glass or two triangles meeting at their apex. Upon the horizontal shoulder line, a partly damaged round head is visible. In consonance with the bronze Dancing Girl of Mohenjo-daro, here too, the right hand is *akimbo*; and the

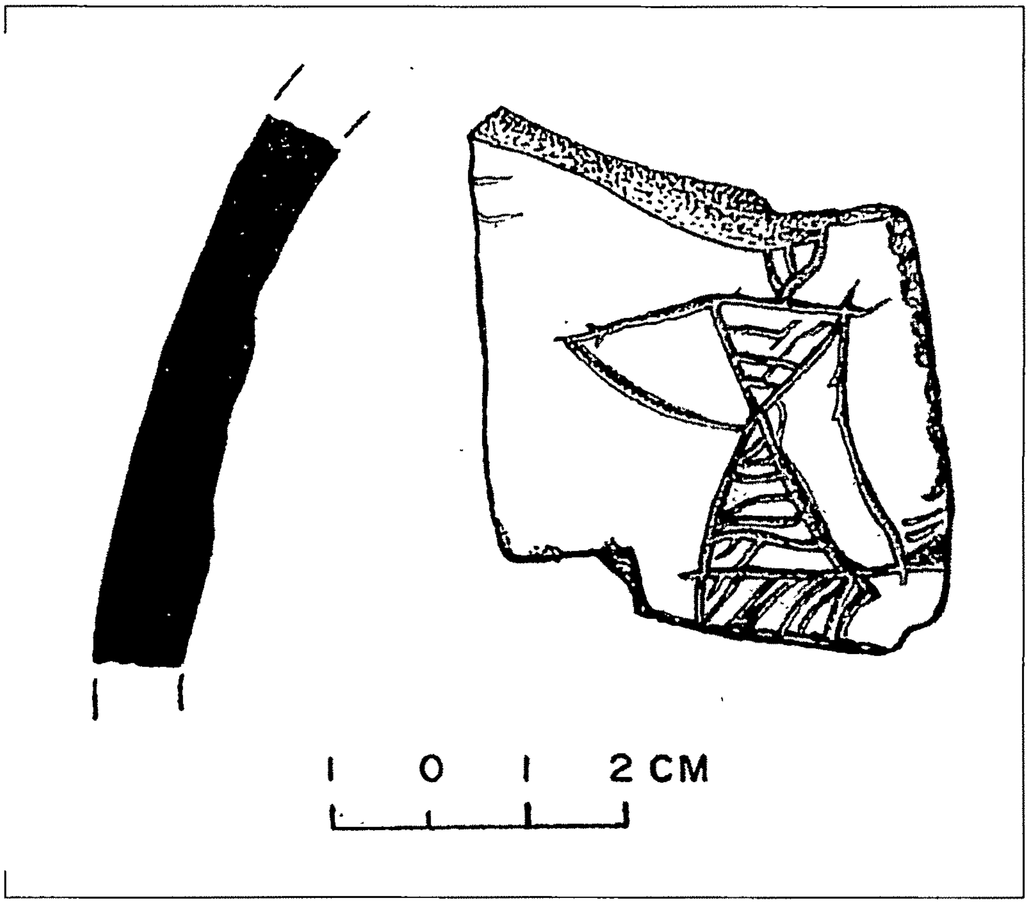

Fig. 1: Bhirrana: Line drawing of Dancing Girl on a Red Ware sherd © ASI

left is suspended by its side. Slight oblique strokes on the right upper arm, are suggestive of the presence of armlets. The lower portion of the body is missing owing to damage on the sherd. The clothing is indicated by horizontal hatchings on the chest and abdomen, and vertical hatchings on the thighs (Fig. 1 and see cover page). It appears that keeping the right hand on the waist/hip in an *akimbo* posture appears to be a popular habit among the Harappan people. Besides the Mohenjo-daro and Bhirrana specimens, two more female figurines are shown with an *akimbo* arm on a Mature Harappan sealing recovered from Chanhudaro (Mackay 1943: 149-50, Pl. LII, 36; Pl. LXXVII, 1).

Unlike negative engravings on Harappan seals, the Dancing Girl of Bhirrana is the product of a post-firing positive engraving on a Red ware sherd. Similar positive–engraved figures in different mediums are known from other excavated Harappan sites. The best examples of a pre-firing engraving alone of a horned deity and a man pulling an animal on a terracotta cake from Kalibangan (Lal 2002: 120, Fig. 4.57), and a pair of human figures in acrobatic exercises on a stone stele from Banawali (Bisht 1987: 150, Pl. 27). Both belong to the Mature Harappan period. A close observation of these figures and the Bhirrana specimen reveals many common features of style and execution techniques. Similarity in anatomical details can be seen in the round heads represented by a miniature circle, placed over the horizontal shoulder line of the *damaru* – or hourglass-shaped torso. Another common feature, especially among the Bhirrana and Kalibangan figurines is the indication of the presence of clothing through horizontal, oblique, vertical and crossing-oblique lines on the bodies.

It is common knowledge that owing to the hard surface of the pot; post-firing graffiti on potsherds, often go awry. However, the Bhirrana specimen shows the craftsman's deftness, in so far as its delineation is concerned, by maintaining near uniform lines all throughout. Further, the delineation is so true to the stance including the disposition of hands of the bronze Dancing Girl of Mohenjo-daro that it appears that the craftsman of Bhirrana perhaps had a first-hand knowledge of the former. Although the Bhirrana specimen has come down to us in the form of a line drawing, the artist has succeeded in bringing out the stylistic resemblance between the two representations.

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V.N. Misra, *Man and Environment* XXXII(1): 110-119 [2007].
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Review Article

Archaeology for Anthropology: Proceedings of the Professor Irawati Karve Birth Centenary Seminar (S.R. Walimbe, P.P. Joglekar and K.K. Basa Eds.), Pune: Deccan College Post-Graduate & Research Institute, 2007, Pages 215. Price: Rs. 500/-

Professor Irawati Karve was one of the leading anthropologists and certainly the most well-known woman anthropologist of India during the twentieth century. She spent all her career (1939-1970) at the Deccan College Post-Graduate & Research Institute, Pune teaching and doing research. Her academic interests were extremely wide and varied, combining biological and social anthropology, origins and functioning of caste, and society as reflected in early Sanskrit literature and contemporary situation. Her research findings, thoughts and theories have influenced the work of a number of anthropologists and continue to inspire others. The Deccan College organized an International seminar in December 2005 to pay tribute to this eminent scholar and assess her work in the context of developments in the discipline during nearly four decades since her death. Seventeen scholars from as many institutions in India and the United States presented papers at the seminar. Besides a number of other scholars from several institutions outside Pune and faculty and students of the Archaeology Department of the Deccan College and Anthropology Department of Pune University participated in the seminar. The papers presented at the seminar were subsequently revised by their authors and have now been published. They are a testimony to the impact of Prof. Karve on Indian anthropology.

Besides the inaugural speech of Dr. V.R. Rao, Director, Anthropological Survey of India and two short biographical sketches of Prof. Karve by A.D. Karve and P.P. Joglekar, the proceedings contain fourteen academic papers which are divided into three sections, namely (1) Prof. Karve's contribution to Indian Anthropology, (2) Cultural anthropology, and (3) Biological Anthropology. Naturally there is a certain amount of repetition and overlap among papers related to the same theme.

We will briefly summarize the individual contributions under each section so that the readers can get a fair idea of the contents of the book.

In Section I the three papers are related to Irawati Karve's place in Indian Anthropology.

Nandini Sundar has divided Karve's work into four categories; Physical anthropology and archaeology: anthropometric and blood group investigations and excavation of Stone Age skeletons; Cultural anthropology: kinship, caste, folk songs, epics, oral traditions; socioeconomic surveys: weekly markets, dam displaced, urbanization, pastoralists, spatial organization; Contemporary social comment: women, language, race

Starting with physical anthropology, Karve slowly moved away to the examination of more contemporary issues. Her main research concern was the biological and cultural variation within India which she valued positively and strongly criticized all attempts to impose uniformity like a common language, common civil code and abolishing caste. While recognizing that caste society prevented nation building, Karve also saw aspects of it like tolerance and awareness of diversity as valuable. According to Karve (1947:17-18), "the unity of India has always been a cultural unity based on an uninterrupted literary and religious tradition of thousands of years". Karve wanted primary education to be in regional language and English to be taught compulsorily from secondary school onwards.

Study of kinship patterns was one of Karve's major academic interests. By relating kinship patterns to linguistic zones, she arrived at following variations:

1. Indo-European or Sanskritic organization in the Northern Zone;
2. Dravidian kinship in the southern zone;
3. A central zone of mixed patterns, found, for example, in Maharashtra; and
4. Mundari kinship systems in the east

Within each zone there are variations between castes and subcastes. The unity in this diversity, according to Karve, was provided by the Shruti literature (Vedas, Brahmanas, Upanishads, and the epics). She compared the North Indian kinship system to Dravidian for its effect on women. In north a girl goes to live with unknown in-laws after marriage whereas in the south because of the cross-cousin marriage a girl lives among known relatives even after marriage. It is very interesting that even among Brahmins in the south who are originally a part of Indo-Aryan society, and who have certainly migrated to south from the north, Dravidian kinship practices like cross-cousin marriage and marriage with one's elder sister's daughter are found, practices which will be considered abhorrent by north Indians. The kinship organization of the central zone, shows greater internal variation than the north with some castes allowing cross-cousin marriage in one direction as in the south.

Sundar has pointed out the strong points as well as the flaws in Karve's Kinship book. She sees Karve as a pioneer of feminist writing in sociology because of her sympathetic attitude towards women suffering social injustice both in the past (the cases of Kunti and Draupadi in the Mahabharata) and present.

Karve's work on caste, according to Sundar, is essentially confined to the origin of caste and the unit of analysis. Karve challenges Ghurye' arguments that caste in India is a Brahminical product of Indo-Aryan culture, spread by diffusion to other parts of India and that the smallest endogamous unit or *jati* was a product of fission in a larger group caused by occupational diversifications, migration, etc. Like J.H. Hutton and other theorists of caste, Karve argued that while *varna* system may have been an Aryan import, it was superimposed on a *jati* system which predated the Aryans. In course of time the *varna* and *jati* system were interwoven into an elaborate ranking system. Karve also argued that sub-castes like the Deshastha Rigvedi or Saraswat Brahmins should be treated as caste while the overall category of all Brahmin castes should be designated as a caste cluster. This is because not only did the various Brahman sub-castes not intermarry but also they had different marriage rules and were ethnically different from each other. Indeed, there were often ethnic variations even within a sub-caste. The Madhyandin Brahmans, according to Karve, came closer to the Marathas within their region in terms of anthropometric measurements than they did to other Brahman sub-castes. Other caste clusters like Marathas, Kunbis, and Kumhars displayed similar characteristics. For Karve her theory of caste fitted the larger enterprise of how the Indian society came to be what it is.

Karve believed that caste helped in understanding migrations in Indian society. The sub-castes in her view are historical entities, preserving in their exclusiveness the memory of some socio-historical event. The generic terms like Brahmin and Maratha are of no value because they are very heterogeneous groups. The Marathas form a conglomerate of different elements. One must therefore investigate separately the endogamous sub-groups of these bigger divisions in order to get a clear idea of the social and cultural hybridization and the historical process of assimilation which has been going on for centuries. She suggested that the sub-castes (for which she used the word caste) should be genetically investigated to understand their migration patterns. In particular she felt that the study of blood groups might help in understanding migrations.

According to Karve (1963c: 4-5), castes show race mixture to such an extent that at least in Maharashtra if people of different castes, ranging from Brahmans to scheduled castes, are put in military uniform, no anthropologist can pick people belonging to different castes. She also thought that in these facts of similarity of appearance and mongrality lie a hope of breaking the caste society once economic equality of some sort and legal equality are reached

Sundar has also analysed Karve's studies of inter-caste relations in villages and the role of markets in promoting integration among people from surrounding villages who attend these markets.

Subhadra Mitra Channa has evaluated Karve's contribution in a theoretical framework. Channa lays emphasis on Karve's feminist approach. In her book *Yugant* Karve shows a very sympathetic attitude to the women characters in the Mahabharata. While discussing the status of Hindu women in mid-twentieth century, she finds the male attitude typical of the patriarchal society. She paints a telling contrast between the carefree and happy life of a girl in her father's house and the suppressed life in her in-laws' house where her identity is merged into that of her husband. She critically contrasts the concept of *pativrata* (wife totally devoted to her husband) as understood in the epic *Mahabharata* and as exemplified in the lives of Draupadi, Kunti and Madri with its meaning in the mid-twentieth century society. In ancient times virtue in a woman had a different meaning. Kunti and Draupadi would not be considered virtuous today due to not being virgins and exclusive sexual property of their husbands. But they were exemplary women of virtue in their own times not because of their sexual purity but because they bowed down to every wish of their husbands and the needs of his patriline, suppressing their own desires and feelings to the dictates of patriarchy. This is illustrated by the practice prevailing in some castes of a woman being passed on to her husband's younger brother or other classificatory brothers to produce male heirs for his patriline.

Karve is sympathetic to the women who are queens and princesses but who have no control of their own bodies, and have to act totally according to the dictates of the male elders. According to Channa, Karve carefully documented and substantiated her arguments and set rigid standards of objectivity for herself.

To clarify the position of woman Karve looks at the laws and customs of those times. A son was important in

Hindu society for a man to be able to discharge one's debt to ancestors and gods not only by himself making sacrifices and offerings to them also by ensuring their continuity through sons. A woman was therefore important as mother for providing sons for the patriline. If she was unable to conceive from her husband, she could resort to *niyoga* by conceiving from a real or classificatory brother of her husband. This raises the position of the mother in giving identity to her sons, but it degrades the position of the wife in that she is obliged to provide her womb for sowing the seed of her husband's patriline. However, one finds it difficult to agree with Channa when she says that "sexual purity of women, a rigid caste structure and enhanced patriarchy are now considered to be more an influence of westernisation than as part of ancient Indian tradition".

Karve's writings refute the commonly held belief that Indian society has been static; instead, they show that it has evolved and transformed over the ages. Karve considered the caste society not a rigid but a loose structure which could take on new units and rearrange old ones. Her reinterpretation of the Mahabharata characters is seen as an expression of her feminist thinking. For example, she sees Gandhari's act of bandaging her eyes not as an act of sacrifice for her blind husband but as an expression of her resentment, anger and revenge for being betrayed. Karve has also questioned the greatness of a number of heroic characters of the epic. For example, she portrays Bhishma, the noble patriarch of the Kuru clan, as very cruel and insensitive to the suffering of the royal women.

S. R Walimbe has given a compact and excellent review of the development of biological anthropology at the Deccan College since 1939 when Irawati Karve joined it as a faculty member of the combined Sociology-Anthropology Department. Karve's main academic interest was to gain an insight into, and find explanation for the immense biological and cultural diversity characterizing Indian society. She undertook several projects, and carried out fieldwork among a number of castes and tribes and generated a vast body of cultural, somatometric and anthropometric data. After analysing the data she came to the conclusion that for the biological and cultural study of Hindu society caste, being an endogamous group, was the proper unit. She suggested the term caste cluster for several castes following the same occupation and having comparable ritual status in society She was of the view that comparisons in respect of biological features should be made between castes or caste clusters rather than between just unrelated geographical or linguistic groups. Karve rejected the prevalent.belief among social scientists that sub-castes are formed by the splitting of castes. She believed that so-called sub-caste does not represent a genuine social group and the term should not be used. She carried out an anthropometric survey of the Marathas and her students like K.C. Malhotra and R.K. Gulati and the latter's students carried out bio-cultural studies of several communities in Maharashtra and other parts of India.

Karve collaborated with her archaeologist colleague, H.D. Sankalia, and anthropologist, G.M. Kurulkar in studying the human skeletons recovered from the excavations at the Mesolithic site of Langhnaj in Gujarat in the 1940s, and was of the view that these early people of Gujarat had Mediterranid physical features.

In 1970 Karve passed away suddenly, and in 1973 anthropological studies at Deccan College came to a stop after the Department of Anthropology was shifted to Poona University campus. However, the Archaeology Department of the Institute was generating enough primary data for anthropological studies. This is because in addition to continuing excavation of Mesolithic sites, now in Rajasthan and Madhya Pradesh, from the 1960s, the Archaeology Department took up excavation of Chalcolithic and Neolithic sites in Maharashtra, Madhya Pradesh, Karnataka and other parts of the country as a major research activity. Sites in Maharashtra and Karnataka yielded human skeletons from burials. These were studied by Dr. K.C. Malhotra of the Deccan College and Prof. K.A.R. Kennedy and Prof. J.R. Lukacs and their students from the Cornell and Oregon universities in U.S.A. However, the amount of skeletal material generated by the excavations was much more than could be handled by these visiting scholars. Hence in 1980 a faculty position of a biological anthropologist was created in the Archaeology Department itself and Dr. S.R. Walimbe was appointed to it. Dr. Walimbe and his students had the benefit of being trained in techniques and theoretical approaches of studies in skeletal biology by the highly experienced American scholars, and therefore their studies are marked by up-to-date and continually improved research methodology.

Early studies, both of living and extinct populations, were mainly concerned with classifying communities into racial categories on the basis of somatoscopic observations on skin and hair colour, hair texture, and other body features and on the basis of anthropometric measurements. Studies of ancient skeletal material were mainly concerned with the shape of the head, face, nose, etc. and stature. The newly emerging approaches, while continuing the somatoscopic and anthropometric studies, shifted their emphasis from racial classifications and biological affinities with other populations to adaptation to environment, diet, pathology, and evolutionary mechanisms. The skeletal material was now studied in relation to physical environment in which ancient populations lived, their occupation, technology used by them, occupational stress and hazards, and trauma. .

Also in the earlier skeletal studies, concerned mainly with racial classification, study of adult crania received maximum attention while post-cranial bones and skeletons of immature individuals were largely ignored. It is noteworthy that a significant component of the Neolithic-Chalcolithic skeletal material of the Deccan consists of sub-adult individuals. The potential of studying such material for tracing the impact of genetic, nutritional, epidemiological, and environmental factors and metabolic disruptions in the early growth phase of life has been amply demonstrated by the large series from Inamgaon and several other sites in Maharashtra and Karnataka.

The rural character of Neolithic-Chalcolithic populations provided little scope for the operation of external biocultural influences, and rendered them ideal for demographic and pathological analyses which provided valuable insights into the biological adaptive strategies of the ancient agro-pastoral groups.

Another important aspect of the skeletal biological researches at the Deccan College is the comparative study of the impact of environment, occupational strategies and nutrition on the health of hunter-gatherers and farming peoples. The skeletal record shows greater skeletal-muscular robusticity and higher ages at time of death among the hunter-gatherers as compared to farming peoples. The higher incidence of pathologies noticed among herding-farming populations is attributed to nutritionally poor diet, periodic famines, food shortages, and high infection rates due to increased population densities. The impact of low nutrition and disease manifest in the skeleton as pathological lesions and are indicators of physiological stress. The stress suffered by agro-pastoral communities is reflected in higher mortality rates, decreased ages at death, retarded body growth, reduced robusticity and stature, and reduced sexual dimorphism.

Common stress indicators in Deccan Chalcolithic populations are Harris lines (disruptions in linear bone growth and enamel hypoplasia (disruption in tooth enamel matrix formation). Such indicators of stress were used to project figures for weaning age and probable population growth rate. Infectious diseases, nutritional deficiencies, traumatic and degenerative lesions leave more specific indicators of stress on the bones and teeth. Porotic hyperostosis, cribra orbitalia (Vitamin C deficiency) and iron deficiency anaemia indicate nutritional stress. Because of the partial preservation of many skeletons and weathered condition of the bones not much information could be obtained for specific infectious diseases such as treponema (yaws/syphilis), or leprosy, but relatively high rates of tuberculosis and non-specific infectious lesions are observed. Indicators of habitual stress during agricultural work are well documented in the skeletal record. Traumatic lesions like fractures, dislocations and artificially induced deformities are also known. Degenerative conditions like osteoarthritis and vertebral osteophytosis are common in old individuals. Dental pathologies like caries, attrition, alveolar resorption (abcess in jaw bone), tartar accumulation and premature tooth loss reflect dietary habits.

Reduction in tooth size among agricultural communities as a consequence of technological development and efficiency of food production techniques has been known from many studies in different parts of the world, including .at Indian Neolithic and Chalcolithic sites. It was further confirmed by a study of the permanent dentition of 10 living and 15 archaeological populations carried out by S.R. Walimbe in the 1980s. Joint studies by teams led by Walimbe and Lukacs and their students have examined various morphological and pathological aspects of deciduous and permanent dentition of both living and prehistoric populations. One of these studies was concerned with the enamel hypolplastic lesions of deciduous canines. One of the objectives of these studies is to verify the archaeological propositions regarding the decline and eventual end of the Chalcolithic culture of the Deccan during the Late Jorwe phase. Dr. Walimbe's team has also made a longitudinal study of the growth of long bones among infants and children. The model of skeletal growth emerging from this study is useful for assessing nutritional status of archaeological populations.

For further progress in palaeopathological studies Dr. Walimbe thinks that better coordination between archaeology and anthropology departments and museums having skeletal collections and expertise is required. Walimbe 's lab is studying human skeletal material excavated not only by the Deccan College but also by a number of other institutions in the country.

Section II on cultural anthropology comprises five papers. Three of these - by K.K. Bhan, J.N. Pal and M.L.K. Murty – take stock of the ethnoarchaeological research.

Since about 1950 the archaeologists themselves are collecting ethnographic data to ensure its authenticity. They attempt to systematically define the relationship between behaviour and material culture and ascertain how certain features of observable behaviour may be reflected in the archaeological record.

K.K. Bhan reviews recent ethnoarchaeological research in western India on metal, stone bead, and pottery making with a view to developing interpretative models that .can be used to test real archaeological situations. He has used archaeological data from Lothal, Bagsara. Nagwada, Nageshwar, and other Harappan sites to demonstrate how ethnoarchaeological studies serve as interface between the archaeological sites and archaeological interpretations.

Bhan discusses the two approaches – *direct historical* and *general comparative* - that are employed by ethnoarchaeologists and cites several experts about their comparative value. He also laments the indiscriminate manner in which ethnographic analogy has been used in the interpretation of archaeological data. Bhan has illustrated the use of analogy by a few select examples.

J.N. Pal has given a brief account of the cultural sequence of the Ganga valley from the Upper Palaeolithic to the Early Historic period and a summary of the ethnoarchaeological studies carried out there in relation to communities still living at least partially by hunting-gathering, fowling, and fishing, selling of flesh and skins of wild creatures, manufacture of various kinds of craft items like ropes, nets, baskets, cups and plates from tree leaves, honey collecting, entertaining people by snake charming, acrobatics, etc, combining these activities, to some extent, with crime. He has referred to the equipment and techniques used by the hunter-foragers. Some of these communities also practice agriculture and horticulture and keep livestock, mainly goats and poultry. Some researchers have correlated food-gathering practices of these communities with those of the Stone Age hunter-gatherers. In fact, there is a continuity of hunting-foraging tradition from the Upper Palaeolithic to the present. Pal has summarized Shahida Ansari's work on the Mallahs, Musahars and Kols of Allahabad district.

Pal has also given an account of the traditional pottery making technology in the Ganga valley by referring to the pioneering work of B. Saraswati and N.B. Behura which describes various aspects of pottery making in different parts of India. Among the tribal communities only some Naga groups make pottery and the work is done by women. In the Ganga pottery making, especially using the potter's wheel, is taboo to women. According to Vidula Jayaswal prohibition of women pottery by women is to maintain secrecy of craft skills. Pal pleads for documentation of traditional practices and techniques before they fall into oblivion.

M.L.K. Murty has provided a very fine analysis of the relationship between village goddesses and the economic, social and religious life of the village people and the insight it offers into the early stages of agro-pastoral economy. It is very significant that almost all over India the priests of the village deities (mostly goddesses) are always men of the lower caste, strongly suggesting that they were the original inhabitants of the village and the deity originally belonged to them. Later on, when Hinduism developed and caste system came into existence, even the people of the upper castes started worshipping the deity to ensure their welfare and protection from her displeasure.

Inter- and intra-caste associations mark the village rituals of the goddess. Even fixing the date of the ritual, called *Jatara*, provides an insight into the village unity. The village elders fix the day after discussion with village people. The ritual lasts three days and people from the village as well as neighbouring villages take part in it. A wooden statue of the goddess is made by the village carpenter. A temporary shrine of wooden posts and cross beams covered with dried sorghum stalks is made. Cooked sorghum, grams and millets are placed inside the shrine in a heap Boiled milk and toddy are brought to the shrine in newly made pots and placed in front of the goddess. . Blood offerings in the form of sacrifices of sheep, fowl and he-buffalo are made to the goddess. The rituals are performed by priests of the low castes. These festivals promote integration of different communities and social harmony.

It is to be noted that though the Brahmanical trinity of Brahma, Vishnu and Mahesh as well as goddesses Lakshmi, Parvati, etc. are unimportant to the lower castes who worship the various folk goddesses, the former do get mentioned in the creation myths of the seven-sister configuration of the goddesses, and show an attempt at integrations of the deities of the Great and Little traditions.

D.K. Bhatacharyaharya examines the possible pattern of combination of numerous evolutionary forces that gave rise to the birth of culture and important trends in social formation. He traces the development of the human skull, jaws, teeth, brain, tool making and cognitive powers after hominoid ancestors came down from the trees and started getting adapted to terrestrial life. According to him *Homo habilis* and *Homo erectus* were capable of only power grip. The precision grip which enabled humans to producer lighter and finer tools evolved in the later Acheulian stage. The proportion of non-vegetarian diet slowly increased and language must have emerged around this time to integrate co-operative behaviour in hunting. Bhattacharya elaborates the role of tool making, fire, language, loss of oestrus, and knowledge in human adaptation and evolution. Delayed maturation in human child and strong mother-child bonding are explained as provisions of time by nature for acquiring the knowledge and strength necessary for survival of the species. During the Acheulian period home base concept is also said to have developed for meeting the requirements of the members of the human group, particularly pregnant females, old people and children. Bhattacharya recapitulates the speculations of various anthropologists regarding origin of the family. Qualities of caring for the mate, children, sick or otherwise handicapped members of the family seem to have originated by early Upper Pleistocene times as seen in the Neanderthal man's burial at Shanidar. To hold the families together bands of multiple families emerged Rules of conduct evolved to ensure the organization of production and survival within the family as well as to ensure inter-group and intra-group harmony. Mate regulation must have evolved to prevent the luring of males of one group by another. Bands came together to see protection from attack by other bands. .

Development of initiation rites for young males in many societies probably developed to deter young males from entering into reproductive activity before they are physically and economically strong to look after and protect their families. Chiefdom developed after the emergence of agriculture as resource distribution and labour had to be controlled. Marriage is believed to have developed at this time as a means of strengthening social ties between two groups. To increase the halo around this institution concepts of chastity, virginity, marital fidelity, etc. were created by the priests and sanctified by religious authority. Rise of complex society came after the emergence of metallurgy and full time professionals. Restrictions on the sexual freedom of women seem to have come fairly late, probably in early historic times or even later. Women were able to choose their mates during the time of the Mahabharata and the Ramayana, that is in the first millennium B.C. Men developed different moral codes for themselves. Not only could they have many legal wives but also concubines and could visit professional prostitutes without any social stigma being attaching to them. These are the major stages through which human society developed from the ape stage to medieval times. The post-epic period has witnessed a steady decline in the status of women as compared to the men.. Bhattacharya has cited examples from the Mahabharata, like Kunti begetting Karna outside wedlock from Surya yet abandoning him out of shame. Thus extramarital relation was not disapproved of but begetting a child from a stranger was. However, she faced no moral stigma while begetting three other sons through Niyoga, which was socially sanctioned.

K.K. Basa has examined the application of anthropological approach or New or Processual Archaeology to Indian archaeology with the help of the writings of three scholars who, according to him, have applied social anthropological theories in Indian archaeology. He mentions at the outset that Indian archaeology combines both British and American traditions by adopting historical and anthropological approaches. New or Processual archaeology developed in the U.S. and U.K. in the 1960s. However, not many Indian archaeologists have taken much interest in New Archaeology.

Basa discusses the use of diffusionist approach in the writings of H.D. Sankalia and Sir Mortimer Wheeler. He contrasts the Irano-centric diffusionism of H.D. Sankalia with the modified diffusionism of Sir Mortimer Wheeler. Sankalia believed that some cultural traits like certain pottery vessel forms and incised terracotta beads were introduced in the Chalcolithic cultures of the Malwa region of central India, and adjoining parts of southeast Rajasthan from West Asia and Turkey, and that Neolithic culture of northeast India was influenced by the introduction of polished stone axes and rice from Southeast Asia. He was of the opinion that nowhere in India there was undisputed evidence of the local evolution of different cultures and the major cultures of India are chronologically later than those of Africa, West Asia and Europe. Basa questions Sankalia's diffusionist explanation saying that there can't be a monocausal explanation of culture change and that morphological similarity of traits does not provide complete explanation of change

For Wheeler diffusionism was a superior explanation of change than evolution. It meant transmission of ideas and not necessarily mass migration of people. Wheeler also believed that the idea of civilization came to India from West Asia but was modified locally, and he also held the Aryans responsible for the disappearance of the Indus civilization although later on he modified this view. He held that Arikamedu with Roman coins, glass and ceramics represents only the transmission of goods and not the concepts whereas at Takshila and Charsada the Greek tradition had truly been transplanted to Indian soil.

The New or Processual Archaeology emphasizes the role of process, and not just the events in cultural evolution. Basa points out that a number of archaeologists starting with P. Mitra in the early part of the last century had realized the importance of the use of social anthropological or ethnographic data in the interpretation of archaeological evidence. S.C. Malik lamented the lack of a processual approach in Indian archaeology, and pleaded for a combined historical and anthropological approach. He laid emphasis on understanding the formation of the Indianness or Indian style and delineation of the process of cultural areas or regional areas which may be correlated in the very early stages to the micro-macro natural subdivisions of the continent.

Basa has compared and contrasted the understanding of, and approach to new archaeology, of three of its proponents in India – S.C. Malik, H.D. Sankalia and K. Paddayya. While Sankalia and Paddayya both practised archaeology as a field discipline and look at New Archaeology from the perspective of practical problems, Malik only talks of theory unrelated to hardcore data. Unlike Binford, Malik accepts Inductive method, limitations of archaeological data and the relative nature of archaeological knowledge. He also argued for adopting a combined historical and anthropological approach. .For Sankalia New Archaeology was a set of techniques and methods, particularly of the physical and biological sciences and of ethnography to tackle problems in the field. Paddayya has combined theoretical outlook with intensive fieldwork. He has also reviewed the application of various aspects of processual archaeology in India – ethnoarchaeology, site formation processes, and middle range theory. And he has incorporated culture history, processual and interpretative framework for Indian archaeology in his scheme of paradigm coexistence. Further, he has emphasized the use of indigenous epistemological tradition for studying the past as well as the indigenous notions for the concept of space, causality and explanation. Basa has also pointed out a few limitations in Paddayya's arguments.

There are six papers in the third section. Rajan Gaur and R.N. Vashisht have provided an excellent review of palaeoecological and palaeontological research, specially that relating to hominoid fossils, in the Siwaliks during the last two hundred years. The Siwalik Hills made up of predominantly fluviatile deposits extend over a length of approximately 2400 km between the Indus and the Brahmaputra at the southern flank of the Himalayas and have a thickness of over 5000 m. They primarily consist of clays, silts, and sands which coarsen upwards. Biostratigraphically the Siwaliks are divided into Lower, Middle and Upper, each of which is further subdivided into subdivisions, namely Kamlial and Chinji (Lower Siwaliks), Nagri and Dhokpathan (Middle Siwaliks) and Tatrot, Pinjor and Boulder Conglomerate (Upper Siwaliks). They range in age between lower middle Miocene to upper middle Pleistocene Palaeomagneticallt they span the period between 18.3 myr to 0.22 myr. The palaeoecological reconstruction is mainly based on megafauna which comes largely from Chinji, Dhokpathan, Pinjor and Tatrot Formations. The Chinji fauna is suggestive of thick woodlands with dense bush cover with warm and humid climate. The Nagri fauna suggests a change from the forested Chinji ecology to open woodlands. The Dhokpathan environment is similar to a wooded savannah. The habitat opened up further during the Tatrot and Pinjor experienced more arid climate.

The authors have provided comprehensive lists of the mammalian taxa of which fossils have been found in the Siwaliks and have attempted a detailed reconstruction of the Siwalik palaeohabitats on the basis of faunal and other evidence.

Arun Sonakia has given a brief account of his already well-publicized discovery of the hominid fossil at Hathnora on the Narmada. The new information provided by him is that the gravel deposit in which the skull cap was found belongs to Middle Pleistocene Surajkund Formation of the Narmada Quaternary sequence as worked out by M.P. Tiwari and H.Y. Bhai (1997). According to K.V.S. Rao *et al.* (1997), who have worked out the magnetostratigraphy of the Narmada alluvium, the age of the Dhansi formation underlying the gravel deposit is 0.76 myr correlatable to Gauss-Matuyama palaeomagnetic reversal comparable to the Olduvai event. According to Sonakia, the near absolute age of the Narmada man could be slightly younger than 0.76 myr., and the morphological details help to classify the skull to *Homo erectus* taxon with characters more in common with Southeast Asian *Homo erectus* crania of Indonesia. Kennedy, however, prefers to assign the crania to archaic *Homo sapiens.*

A.R. Sankhyan has examined the current status of Hominid fossil finds in India. He has briefly summarized the history of geological and palaeontological research in the Narmada valley from W. Theobald (1881) to the present. Theobald distinguished two groups – the Lower and Upper - in the Narmada sedimentary sequence, the Lower Group comprising the basal boulder conglomerate bed and the Upper Group constituting the pale brown sands and loose conglomerate alluvium with the Black Cotton Soil at the top. De Terra and Paterson noted red clay underlying the basal gravel and unconformably overlying the laterite formation. According to Sankhyan, the post-cranial elements are useful for reconstructing the body dimensions and adaptations of the Narmada hominins. On the basis of the 90 mm length of the clavicle, Sankhyan has estimated the shoulder width of its owner to be 30.6 cm. He thinks that the Narmada hominin was similar to the Andaman Onge females in the width of its thorax. He has calculated the stature of the hominin, on the basis of the length of the clavicle, to be between 115 and 135 cm, a value which shows the Narmada hominin to be shorter than even the modern female pygmy. This size is nearer to the Indonesian Hobbits, *Homo floresiensis*, and the east European Damnisi, *Homo georgicus.*

Sankhyan has also calculated Narmada hominin's chest depth and adaptations on the basis of correlation between the conoid index and the second rib curvature. The conoid indices fall in the Pygmy range (76.7 to 83.80) and suggest a modern type moderate chest depth and warm humid tropical adaptation

According to Sankhyan comparisons of the Narmada hominin with various middle and late Pleistocene hominins and recent humans in respect of clavicle length, mid circumference and calibre index support the inference drawn from the conoid index, namely that the Narmada hominin is a modern *Homo sapiens*. The mid-shaft index exhibits a general evolutionary trend – the flattened diaphyses in early hominins through the intermediate condition in some of them and the rounded diaphyses in modern humans. The conclusion is reached from the fact that the diaphyses of *Australopithecus afarensis* (68.6 cm) and early African *Homo ergaster* (55.8/61.7) exhibit platycleidy, whereas the diaphyses of the Olduvai Homo - OH 48 and the Zhoukoudien *H. erectus* show mesocleidy. The Narmada clavicles (78.6 / 80.0 cm) exhibit further evolution by showing higher mesocleidic condition or touch the eurycleidic condition. The Neanderthal clavicles (68.4 ± 9.1 cm) stand distinct by exhibiting a primitive platycleidic-mesocleidic condition.

The exceptionally high calbre and robusticity indices of the Narmada clavicles attest very strongly developed nuchal and pectoral muscles, suggesting a uniquely very stout, robust and short-statured anatomically archaic hominin, even shorter than the shortest extant female pygmy of the Andaman Islands . On post-cranial evidence the Narmada hominin could be excluded from the Neanderthals or the hominins akin to Neanderthals. If the post-cranial bones belong to the calvaria, they indicate a very unique hominin possessing a large head (ca. 1300 cc) on unusually short/dwarf body, similar to small-brained *Homo* *georgicus* from Dmanisi in Georgia, and small-brained *Homo floresensis* (the Hobbits) from the Flores Island of Indonesia. Alternatively, the calvaria belong to a Neanderthal/ Pre-Neanderthal European immigrant and the post-cranial bones belong to a different robust pygmoid hominin.

Prof. K.A.R. Kennedy has been actively involved in palaeoanthropological research in South Asia for over four decades. He had examined Langhnaj Mesolithic skeletons in the early 1960s including one specimen from his own excavation in 1963-64. He had also had personal interaction with Irawati Karve. In his present contribution Kennedy has given a brief history of the development of biological anthropology, including palaeoanthropology, in India, and has highlighted the important research issues which received the attention of anthropologists of Karve's generation like the identification of the hominid species who produced the tools of different Palaeolithic industries, authors and successors of the Indus Civilization, identification of the cultural and biological remains of the speakers of Indo-Aryan languages, etc.

From about 1960 onwards, in addition to taking anthropometric measurements and identification of races which had dominated biological anthropology till then, consideration of the issues of genetics became important to anthropologists. Irawati Karve grasped the importance of new development in the discipline. Genetic traits were an important element of her research as she and her students surveyed morphological features considered to be under genetic control – dermatoglyphics, skin colour, hair form, eye pigmentation, anthropometrically measurable variables, etc. Distributions and frequencies of observable traits bore implications for the biological relationships of tribal and caste groups to one another.

Around the middle of the twentieth century biologists realized that the so-called subspecies (equivalent of races in biological anthropology) were arbitrary divisions within the natural world. The concept of race became discredited in anthropology around this time. In the same period the study of human biological diversity in genetics and in the morphology of populations adapted to different environments gained importance. In addition to palaeoanthropology studies, new areas of investigation were human growth and development, nutritional status, birth weights, body forms of trunks and limbs, cranial variables, susceptibility to diseases, and the demographic profiles of mortality, morbidity, fecundity, muscular-skeletal robusticity and health. Palaeodemography seeks to apply these variables to ancient populations for which a skeletal record exists. Forensic anthropologists practice many of the procedures employed in the field of physical anthropology and archaeology.

By the dawn of the present century, genetics appeared to hold the key to unlock many mysteries of the past and reveal degrees of genetic relationships of contemporary populations around the world. However, according to Kennedy, when we seek to find a genetic basis for physical variety, we come across minimal genetic data to explain morphological features, such as stature variables, differences in metabolic rates, frequencies of dizygotic twins and other distinguishing features of modern populations. Therefore, anthropometric and morphological examinations of living bodies as well as skeletons, ancient and modern, remain a critical element in understanding the effects of natural selection, mutation, drift, chromosomal re-assortment and sexual selection in our species, problems not yet resolved by study of the genotype.

According to Kennedy, DNA analyses of ancient bone lead often to disputable results, as in the case of recent attempts to extract DNA from Neanderthal bones in Europe and Late Pleistocene anatomically modern humans from Sri Lanka.

Kennedy has listed the research priorities before South Asian palaeoanthropologists. These are: antiquity of the earliest hominids in South Asia; the biological affinity of the prehistoric skeletons with historic and later populations; effects of prehistoric socio-economic and technological changes on human body form and shape, muscular-skeletal robusticity, sexual dimorphism, ontogenetic growth and development, and dental variables of size and morphology; identification of biological properties which are adaptive to the transition from hunting-gathering to food production; place of South Asian palaeoanthropology in the global context, specially in regard to the Indo-European languages, the concept of the Vedic Aryans, migration of foreign peoples and patterns of gene flow, and diffusion of cultural elements and institutions within the subcontinent and across the borders, position of South Asia vis-à-vis the migration out of Africa or indigenous evolution of anatomically modern humans; and employment of new investigative strategies for the recovery of hominid fossils. According to Kennedy, while genetics will continue to provide data applicable to drawing up diagrams for a clearer understanding of biological relationships among modern human populations, it is not the key to understanding those variables of the human skeleton unrecorded in the genotype, like markers of occupational stress and trauma, rates of growth and development, body forms, artificially created deformations of bones and teeth and other indicators of adaptation to natural and cultural stresses within different geographical environments.

Like Prof. Kennedy, his student, Prof. J.R. Lukacs has also devoted over three decades to the study of human skeletal remains, particularly dentition, of Mesolithic, Neolithic, Chalcolithic, Harappan and Megalithic populations of South Asia. In his present contribution he has evaluated the contribution of Irawati Karve to biological anthropology, particularly her theory of caste origins, and has discussed his own research on issues, specially stature,. which were of interest to Prof. Karve,

In her research in biological anthropology Karve examined the interplay between social systems and biological diversity. The effects of caste endogamy on the genetic and anthropomertric characteristics of castes and tribal peoples of India were a prime focus of her research. She sought answers to such questions as; the degree of similarity or distinctiveness of castes and tribes from one another in terms of morphology and genetic structure; nature of differences between castes and between castes and tribal populations in traditional phenotypic components such as stature, skin colour and cranial shape. The co-existence and functional integration of caste groups provided the motivation for Karve's research. She was interested in finding out the processes and mechanisms which were responsible for the origin of castes and of the caste system itself. The general belief among social scientists about the origin of sub-castes was that they originated through the fission of larger castes. Karve wondered if biological variation among castes can tell us about the origin and early history of castes. Her research hypothesis was that is sub-castes displayed a high degree of biological similarity, then fission from a common ancestral group would be a reasonable explanation of caste formation. Alternatively, if sub-castes are biologically dissimilar and display numerous and significant differences in their genetic and anthropometric traits, then they likely represent heterogeneous amalgamations formed by the fusion of distinctive groups with divergent past cultural and biological histories. In their 1968 article, Irawati Karve and K.C. Malhotra examined the anthropometric and genetic attributes of eight endogamous Brahmin castes of western Maharahstra. Though comprising only 9 % of the Maharashtrian population the eight endogamous Brahmin castes displayed significantly higher levels of inter-group biological heterogeneity than more numerous groups comprising the Maratha-Kunbi caste. Some Brahmin castes like the Deshastha Rigvedi or Saraswat Brahmins, were found to be more similar in anthropometric and genetic trait frequencies to non-Brahmin castes, such as Marathas and Prabhus than they were to one another. This observation that the aggregation of endogamous Brahmin castes with similar socio-economic status exhibited significant biological heterogeneity, suggested that they attained similar status at different times and through unique historical pathways. A new term 'caste cluster' was coined to reflect biological diversity in anthropometric and genetic attributes among Brahmin endogamous groups. Karve and Malhotra concluded that the fusion model of caste origins played a more critical role in the formation of Brahmin caste cluster of western India than previously believed and had greater general relevance than the fission model. Findings of researches among other caste clusters, particularly the Kumbhars (potters) by Karve's students and the latter's students were similar.

Karve studied the Mesolithic skeletons from Langhnaj in the mid 1940s. At that time stature was calculated from long bones without reference to other factors. Lukacs' review of research on past and present stature in India shows that trends of increase or decrease in stature reflect adaptive responses to nutrition, occupation, and environment. Bioarchaeological research from Mesolithic sites in northern India reveals tall stature of early foragers and hunters. Estimates of mean stature for inhabitants of Damdama reveal tall males (179.1 cm. ± 8.1; n=18) and tall females (173.0 cm. ± 10.1; n =11). These estimates along with those for Sarai Nahar Rai and Mahadaha indicate that early hunters and foragers of the Ganga plain were unusually tall. According to Lukacs (2007: 197), the tall stature may have conferred an adaptive advantage with regard to physiological stress in hot dry climatic conditions and to enhance locomotor efficiency facilitating logistical and transhumant mobility. Lukacs has provided a graphic comparison of stature estimates for Ganga plain male samples with early farmers and nomads of northwest India and with living castes and tribes of India. He chose three groups of sites for comparison on the basis of subsistence pattern, geographic location and chronological context. Group1 represents early Holocene hunting and foraging people of the Ganga plain. This group is chronologically the earliest and phenotypically the tallest, with an overall average stature of 179.9 cm (± 6.5). Group 2 consists of seven early farming and nomadic skeletal samples from northwest India. It includes Harappan agriculturalists from Harappa (cemeteries R37 and H), Lothal and Mohenjodaro, whose overall stature is 172.2 cm (± 7.5), as well as series from Timargarha (TMG), Burzahom (BZH), and Chalcolithic Mehrgarh (MR2). The third group consists of living castes and tribes of India. Data on the stature of fifty populations of both castes and tribes collected by P. Ganhuly and A Pal in two studies separated by 25 years show that the mean stature of caste populations in the two studies is 164.2 cm and 163.3 cm and for tribes it is 161.5 and 160.7.

According to Lukacs, stature decline is almost a global trend. Evidence from South Africa is similar to that from South Asia. Three studies over the short and long-term provide evidence for a sustained negative secular trend in stature from three continents. One analysis is based on 21 western European samples over two millennia; the second on 322 samples from Latin America over eight millennia, and the third on Malyasian samples from the mid-Holocene to the twentieth century. In all the three studies a strong association between stature and the quality of the biologic and socio-economic conditions of life is revealed in different geographic settings and chronological samples.

Lukacs' research on ancient dentition shows that numerous and highly heritable morphological variants of the dentition provide more accurate estimates of population affinity than do environmentally malleable measures of affinity such as craniometric variables. Cultural changes in subsistence including greater reliance on, and intensification of, farming, have resulted in worse dental health generally and a significantly greater decline in the oral health of women than of men. This widespread sex difference became more divergent through time and is best measured in archaeological samples by sex differences in dental caries prevalence.

In the last paper in this section Walimbe has discussed the potential of DNA as a research tool in the biological analysis of Indian society. DNA studies are helping in understanding man and his environment at the genetic level and unravelling his genetic relationship with other primates, variation and migration in contemporary populations. Changes in population structure, movement patterns during the past, language evolution and the origins of infectious diseases, etc. can be explained using information at the molecular biological level. Nuclear DNA provides information about the individual genetic constitution and kinship in relation to other individuals. Since the mitochondrial DNA exclusively comes from the maternal side, a maternal lineage within a community or a population can be traced using mitochondrial DNA sequences.

On the basis of striking similarities in great apes and man Darwin and other evolutionists of the nineteenth century had concluded that these primates had descended from a common stock. Most members of the scientific community as well as general public were opposed to this thesis. Till the 1960s most palaeoanthropologists defended that split between *Homo sapiens* and African apes occurred as early as 30 million years ago. Close relationship among chimpanzees, gorillas and humans is confirmed from the differences in immunological properties of specific proteins. Further research enabled dating of the chimpanzee-gorilla and human divergence at around five million years ago, and revealed that chimpanzees are more closely related to humans than they are to gorillas. Molecular biology has brought accuracy in the measurement of the degree of genetic difference among apes.

Molecular biological research has shown that mitochondrial DNA (mtDNA) accumulates mutations at a much higher rate than the genes in cell nuclei and therefore could provide adequate calibration for understanding recent population theory and it also offers a powerful tool for inferring population history. On mtDNA evidence it has been proposed that modern human everywhere are descended from an ancestral African population of around 150,000 years ago.

Molecular research can help verify issues relating to population migrations since prehistoric times by tracing the chronology of appearance or disappearance of mutations, and by phylogenetic analyses. Study of the DNA of ancient skeletons and of contemporary populations will help in understanding the origins of biodiversity and trace the human evolutionary and migratory history in India during the prehistoric period. If a population breaks up and the new parts remain isolated for a long time, it leads to genetic drift and hastens the pace of genetic diversity among sub-populations. An admixture between sub-populations will lead to increased genetic affinities. Cultural and linguistic factors prevent free mixing and therefore genetic diversities should be correlated with linguistic and cultural histories.

India has enormous linguistic diversity, with over 325 spoken languages and dialects. These languages belong to four major families, namely Austro-Asiatic, Sino-Tibetan, Dravidian and Indo-European or Indo-Aryan, and are believed to have appeared in that sequence. The areas of Austro-Asiatic, Sino-Tibetan and Indo-European languages are extensive but since Dravidian languages are mainly spoken in India, they are generally believed to have originated indigenously. DNA analyses of the speakers of the four language families can tell us their relative antiquity and thus help us understand the chronology of the peopling of India. Similarly, DNA analyses of dated prehistoric human skeletons from various sites and their comparison with modern Indians can tell us about the relationship of living populations with prehistoric ones. Walimbe has taken initiative in establishing a collaborative programme for such studies with the Hyderabad-based Centre for Cellular and Molecular Biology (CCMB).

The proceedings contain very informative and thought provoking articles and are a fitting tribute to late Professor Irawati Karve. The organizers of the seminar and editors of the proceedings deserve congratulations for carefully planning the seminar and bringing out the proceedings within one year.

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Book Review

Shukla, K.S. 2007. *The Decipherment of the Indus-Saraswati Script*. New Delhi: B.R. Publishing Corp. Rs. 600/- (ISBN81-7646-566-6).

The Indus script thus far has remained undeciphered in spite of the best efforts of many scholars, but from time to time attempts nevertheless are being made. The book by Karuna Shankar Shukla is one such attempt. He has been working on this theme for quite some time, and his continuing efforts bore fruit in the form of this monograph.

Karuna Shankar Shukla is a trained archaeologist and during the course of his explorations in the Ganga Valley he came across a seal that led him to attempt a decipherment of the Indus script. The study is divided into seven chapters. The first chapter outlines the history of decipherment, and following chapters contain his reading of a seal found at Kanpur (Indiranagar mound). It is a square seal divided into four compartments, each marked with two or three vertical strokes, which according to him represent a child's age, pots or cows. He thinks that the seal is pre-Harappan as it is associated with the OCP and copper hoard culture, and occurs on a bronze celt from Pariar. He places the OCP/copper hoard culture in the fourth millennium because of the similarity between a buff seal from Ahichchhatra and the pre-Harappan buff ware from Kalibangan, which is however tenuous.

The author avers that the knowledge of the Vedas was enshrined in Old Brahmi and assigns phonetic values to different Harappan signs. He has thus read a few seals and has assigned them meanings with the help of Vedic hymns. S.R. Rao's reading is different, though both he and Dr. Shukla have employed a similar method. Shukla concludes; "Thus, the aforesaid ancient Indian seals and sealings from Harappa and Mojenjodaro represent Vedic hymns and were used as a material and aid to the Vedic scholars in the areas beyond the Ganga-Saraswati Valleys- the cradle of Vedic Civilization." (p. 31). He also finds the names of Puranas on seals. It is not clear why the names of Puranas should occur on Indus seals. Above all the author does not explain on what basis he has assigned specific phonetic values to particular symbols.

There are some lacunae in this book which may be mentioned. It is not clear whether the seal with five strokes is from Indiranagar or Bangarmau or whether these are one and the same locality. Plates have been repeated. It is not comprehensible why one Kalibangan seal (Plate IVC) with eight signs should have word *pancha* stated in four different ways (p. 34). Some of the appendices have not been mentioned in the text and some of these are not numbered. Plate IXD depicts a unicorn seal. The description of *parna* (papal leaf), and two unicorns according to him represent *Suparnas*. Suparna in the Rigveda is celestial bird and not a unicorn. One copper tablet is supposed to be equated with musical notes. All these need satisfactory explanations. Further, the identification of Meluha with Malwa cannot be accepted. These are some of the shortcomings of this book which if organized properly would have been interesting.

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Book Review

Archaeology of the Chotanagpur Division (Jharkhand), by Dilbar Bhengra 2007. Delhi: Agam Kala Prakashan. Pages 187, Price Rs. 1100/-

The book entitled "Archaeology of the Chotanagpur Division (Jharkhand)" is based on the doctoral thesis of the author submitted to the Magadh University, Bodhgaya. It is divided the book into seven chapters with a conclusion followed by bibliography. In the first chapter author has discussed geography and geology of the study area. It gives a detailed account of the rocks, minerals, river system and forests of the region. Geographically the Chotanagpur Plateau covers a vast area and includes 18 districts.

The prehistory of the Chotanagpur is given in chapter 2. Here the author has discussed previous work on the Old Stone Age, Upper Palaeolithic, Mesolithic and Neolithic in the region. After this he has summarized a report on four excavated sites namely Loapahar (Stone Age site), Barudih (Microlithic and Neolithic), Sonua Nullah and Dungi. (Neolithic).

Chapter 3 deals with early history of the region. The author has described the distribution of various tribal communities who migrated into the Chotanagpur area and occupied different parts of the region. According to him the Kharia is the ancient-most tribe. They still exist but in a very small number. Based on the this description the author has argued that about a thousand years back, almost all the tribes had settled in the Chotanagpur region. In the later period these tribes were influenced by Buddhism and Jainism. The region was once an important centre of Buddhism.

In Chapter 4 the author has briefly discussed about Copper hoards from Patna Museum.

Chapter 5 is devoted to art and is sub-divided into three sections: Stone Sculptures, Bronze Images and Prehistoric Rock Art. Dr. Bhengra has given detailed description of the ancient art in the form of stone sculptures, bronze images and rock art in the Chotanagpur region. Though there is ample evidence for the ancient art and architecture, author has rightly pointed out that they are in ruined conditions.

The next chapter is on architecture and it describes six Siva temples in the region. This is followed by the last chapter on inscriptions and coins. In this chapter the author has given account of four inscriptions reported earlier. They include the Dudhapani Rock Inscription which is the oldest in the region.

At the end the author has given concluding remarks on his work which is followed by the bibliography.

Although the book looks to be a compilation of previous work and lacks critical review, it is a welcome addition to those interested in general archaeology as it gives information right from prehistoric period to the Early Historic period of the Chotanagpur region.

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Conference Report

Report of the ICREA International Conference on 'Plio-Pleistocene Climatic Changes, Faunal Turnovers and Human Dispersals" held in Tarragona, Spain on May 4-6, 2006

I participated in the ICREA (*Institucio Catalana de Recerca i Estudis Avancats*) International Conference on "Plio-Pleistocene climatic changes, faunal turnovers and human dispersals" held in Tarragona, Spain on May 4-6, 2006 as a student delegate from the University of Rovira i Virgili, Tarragona. The conference was devoted to the questions of "Out-of-Africa" scenario in relation to climatic change and its implications for the faunal record and its possible relationship with human dispersal to Eurasia. The recent discoveries from the site of Dmanisi in Georgia, Caucasus dated to 1.8 mya during the Plio-Pleistocene boundary with human remains and fossil assemblage of mammalian fauna have significantly changed the ideas of the early human colonisation of Eurasia. The new study of faunal material from Europe shows many dispersal events, extinctions and evolutionary patterns related with the climatic factors.

The conference started with a discussion on the Plio-Pleistocene climate change by Peter de Menocal and Martin Trauth. It was followed by a round table discussion on the Plio-Pleistocene transitions and early Pleistocene climatic changes, chronological issues, floral and faunal turnovers, with special emphasis on the first human colonisation of Eurasia, chaired by F. Clark Howell and Marina Mosquera.

David Lordkipanidze discussed the environmental scenario on the first out-of-Africa hominids taking the evidence from southern Caucasus including Dmanisi showing the adaptations of early homo to temperate landscapes. One of the very important issues was the ecologically significant large mammalian data from the species of African origin such as the large monkey *Theropithecus oswaldi*, the aquatic megaherbivore *Hippopotamus antiquus*, and the sabre-toothed tiger *Megantereon whitei* and their arrival in Eurasia at the Plio-Pleistocene boundary. An interesting correlation was discussed with a significant faunal turnover and its possible relations chronologically to early human dispersal. The bio-chronological marker on the basis of micro-mammalian record was examined by Jordi Agusti with a special emphasis on the rodent communities. Another important aspect of the discussion was the evolution of climate from Pliocene to Pleistocene in Europe, Middle East and Peri-Mediterranean regions considering pollen record. There were discussions on the lithic industries from the sites of Barranco Leon and Fuente Nueva 3 of Orce, SE Spain with a precise dating at about 1.2-1.3 Ma, which were considered by the author Isidro Toro Moyano to belong to the Pre-Oldowan cultures of East Africa, Georgia and Southern Europe.

On the second day, there was a field trip to the new site of Vallparadis in the centre of Terrassa which presently represents the oldest record of hominid presence in Catalonia region of Spain. The site has yielded lithic artefacts of great quantity with the presence of large palaeontological material of a late Villafranchian fauna together with early Galerian elements in a reverse palaeomagnetic chron suggesting a chronology around 0.9-1.0 Ma. The site again proves early human presence in southern Europe with a long chronological point of view.

The second round table discussion was on the Early-Middle Pleistocene transitions and the early Middle Pleistocene, chaired by Henry de Lumley and Robert Sala. The problem related to dating has been a topic of continued discussion in European Prehistory. The over dependence on the relative dating methods raises many doubts on their authenticity. Jan van der Made discussed the virtual absence of radiometric dates, and its implications to the problems like the date of sites older than Jaramillo Event and younger than Olduvai Event. He opined that the dates can move up and down by nearly half a millions years. The dispersal of fauna like bisons, *Soergelia*, etc. is related to faunal change and global climate and its relations to human dispersal at around 1.2 Ma to Western Europe. The two key sites Ubeidiya and Gesher Benot Yaaqov of Dead Sea Rift, with continuous and prolonged human occupation were presented by Naama Goren Inbar form the palaeoclimatic point of view. Different dispersal patterns with different traditions, but within the same Acheulian culture, were inferred as hominin behavioural modes. The end of Mode 1 technology and the beginning of the Acheulian tradition in Europe was another issue of discussions. One very interesting inference by Manual Santonja was the absence of sites closer to watercourses during the Lower Pleistocene of Iberian Peninsula, and he thought that this may be related to a predilection for other environments, particularly caves and lake shores. He commented that the Acheulian material from sites like

Torralba and Ambrona represents a unitary phenomenon which does not show evolutionary or developmental stages in technology. The two different zones, taking south of Caucasian Ridge at the east and the Iberian Peninsula and Italy including England and Germany in the west has a large gap in between for the Acheulian finding, which may further imply a North African provenance for Western Europe.

The final session was on the late Middle Pleistocene and Late Pleistocene hominid development with special reference to *Homo heidelbergensis / Homo neanderthalensis* and the arrival of the *Homo sapiens* around 40 ky into the European continent. Circumstances leading to the arrival of modern humans in Europe and its implications were the other interesting topic for discussion, which was chaired by Maria Rita Palombo and Gloria Cuenca.

Listening to these recent happenings in Eurasian Prehistoric and palaeoenviornmental study was very educative. It opened a new dimension for correlations between climate change and human evolution and dispersal during the Pleistocene, gathering data from various related fields in mammalian palaeontology, palaeobotany, palynology, palaeogeography, palaeoclimatology, and prehistory. At the concluding ceremony of the conference a dinner was organised at Hotel Imperial Tarraco, with special meal of delicious duck meat., Wine toasts were raised for the organisers. Bienvenido Martinez-Navarro, Antoni Rosell, Francesc Burjachs and Robert Sala, and their assitants.

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Obituary

Prof. Abu Imam (1929-2007)

It is with deep sorrow I am remembering the unexpected and sad demise of Professor Abu Imam. He was an eminent archaeologist and historian of Bangladesh. He was the pioneer in the field of Archaeology in Bangladesh and introduced institutional Archaeology in the country, which made him to earn the respect and name as the 'Father of Bangladesh Archaeology'. This renowned scholar passed away on 27th February, 2007 after a short illness, later followed by a mild heart attack at his residence in Uttara, Dhaka, Bangladesh. The sudden departure of Professor Imam is a great loss for the country, especially in the field of Archaeology.

Professor Abu Imam was born in a highly educated and respectable Muslim family on 6th December 1929 in Kolkata. His father, late Ali Mohammad served as an Assistant Registrar of Kolkata and Dhaka High Courts. Professor Imam's original home town was in Hoogly but due to the profession of his father he had his primary and secondary education from Howrah Zilla School. He passed S.S.C. examination in 1944 and H.S.C. examination in 1946 from Scottish Church College, Kolkata. He then took admission in B.A. Hons. in History in Presidency College, Kolkata, but due to the partition of India in 1947 his parents migrated from Kolkata to Dhaka and he had to take a readmission in the same discipline at Dhaka University. He obtained his B.A. Hons. and M.A. degrees from Dhaka University in 1950 and 1951 respectively. He then joined as a lecturer in the Department of History, Dhaka University. In 1953 he was awarded Government Overseas Scholarship for study at London University. In 1956 he obtained another M.A. degree (with thesis) in Archaeology from the School of Oriental and African Studies (SOAS), London University under the guidance of Professor K.de.B. Codrington and under the co-supervision of Professor Gordon Childe and Sir Mortimer Wheeler. He obtained his Ph.D. degree in 1963 from the London University under the supervision of Professor A.L. Basham.

Professor Imam's basic degrees were in History, especially on Ancient Indian History but he obtained knowledge about Modern Archaeology from A.H. Dani, K.de.B.Codrington, Professor Gordon Childe, Sir Mortimer Wheeler and Professor A.L. Basham. He continued his work in this discipline till his death. In his long career he served in many universities at home and abroad and left no stone unturned to promote Archaeology in Bangladesh.

In early 1950's Professor Imam and Professor Dani together introduced Archaeology Group at M.A. level in the Department of History of Dhaka University. But their program did not run for long since Professor Imam was away from the country for his higher education and profession (he was a Fellow of St. Antony's College, Oxford University from 1966-1970). In 1971 Professor Imam joined in the Department of History, Rajshahi University and made several attempts to open a separate department for Archaeology at the university level but his efforts to introduce this discipline remain unsuccessful for a while. He apprehended that until and unless an academic department for Archaeology can be opened in the university level, the academic research on art, architecture and heritage of the country will not be fully accomplished. He then got an opportunity to join in the Department of History, Jahangirnagar University in 1980, which is near to the capital of the country. His endless efforts continued and finally materialized in 1985, when he received a grant from Ford Foundation, Dhaka Office, to open up a separate discipline for Archaeology at Jahangirnagar University, which is now a full fledged and only Department at the university level in Bangladesh. Prof. Imam retired in 1990. However, even after his retirement, in many ways he served the departments of History and Archaeology of the country till his last breath.

Prof. Imam was an outstanding scholar, innovative, soft spoken, knowledgeable and dignified person. And over all he was respected by all scholars and academicians of the country. Apart from his mother tongue Bengali, he knew English, French, Sanskrit and Hindi which enriched his professional career. He wrote many articles and books. His noteworthy work was on the contribution of Sir Alexander Cunningham in the field of Archaeology of the then Indian Subcontinent. His book *'Sir Alexander*

Cunningham and the Beginnings of Indian Archaeology' was published by the Asiatic Society of Pakistan in 1966. The endeavor received favorable review in the *American Historical Review*: "This study is a first-rate piece of scholarship, well documented and organized. .... The flavor of the book ... is one of excitement and discovery.... For his critical and excellent survey ... Imam has our gratitude." (June 1968). He was a good critic and always tried to present the archaeological records in an interpretive and meaningful way. His recent (2000) publication *Excavation at Mainamati: An Exploratory Study* is designed both to describe and interpret the structures and materials unearthed by the excavations of the Department of Archaeology since 1955.

In his unique years of teaching he hold the post of Chairman, Dean and Provost of several universities and became member, president and advisor of various academic organizations. He obtained many academic distinctions such as appointed Fellow in Pakistan Studies at St. Antony's College, University of Oxford, commissioned by Pakistan Government to write standard history textbook, consultant to UNESCO project of History and Archaeology of Central Asia, and member, Pakistan National Committee for International Council of Museums (ICOM) UNESCO.

Being his student I was very fortunate to receive his love and affection. He used to share his ideas, thoughts and knowledge with me. I found him as an enlightened friend, guide and philosopher. He always used to appreciate his students and friends for developing new thoughts and learning. During his presence all archaeologists of the country felt to be sheltered under a single umbrella. His sudden absence is a great loss for the country and we will miss him in every pace of our academic and personal life.

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Obituary

Munish Chandra Joshi (1935-2007)

Munish Chandra Joshi, a former Director General of the Archaeological Survey of India, (ASI) expired on January 1, 2007. In his death we have lost a fine person and an outstanding scholar. An academic to the core, Munish Chandra Joshi was a polymath in the true sense. He had an almost encyclopaedic knowledge and understanding of virtually every aspect of our country's past. It was indeed amazing to find him discussing different subjects with an in-depth understanding from prehistory to different periods and epochs of our history right up to the contemporary times, art and architecture, iconography and iconology, painting, numismatics, inscriptions, rites and rituals, social systems, Tantra, original texts, Sufism, colonial or domestic architecture, astrology, gems and jewellery, popular and folk traditions, conservation of monuments including material used, etc. His filed of specialisation included early historical archaeology, Buddhist, Jaina and Hindu art and Indo-Islamic art and architecture. He would discuss, explain and elaborate on endless variety of subjects and topics and left everyone wondering about his range of information and knowledge. Those who had not come in his contact may be wondering if it is rather exaggerated. His son, Prateek recalls: "To my father, learning was a vocation that kept him active and intellectually agile till his last day. He derived immense joy by talking and discussing things that caught his attention. His range of interests and passion often made him switch topics during a conversation with such frequency that others who didn't know him closely, sometimes found it a bit irritating. … He never structured his life, he let his thirst for knowledge guide him. Whether he worked long hours in the office, or spent time at home preparing for a radio talk, his inquisitive mind was always busy. Often he came home in the evening, beaming like a child, when he stumbled upon a new idea, concept, text or an inscription … He loved studying history, society, art and architecture, not only of India, but other ancient cultures as well. His broad academic mind led him to question ideas that many treated as articles of faith … ".

Munish Chandra Joshi was born on 30 March 1935 at Haldwani in Uttarakhand and had his early education in Nainital. After passing Master of Arts in history with distinction from Lucknow University, for which he was awarded a gold medal, he joined the ASI in 1956 at Ajanta. Thereafter, he served in various capacities in the ASI before he became its Director General. After his retirement in 1993, he joined the Indira Gandhi National Centre for the Arts (IGNCA), New Delhi, the same year as member secretary and served the organisation with distinction till 2000.

During his tenure in the ASI he carried out archaeological investigations in different parts of India and made in-depth study of monuments and museums. He was associated with planning and execution of work at Taj Mahal, Fatehpur Sikri, Ajanta, Elephanta, Jagannatha temple at Puri, Monuments in Goa, Angkor Wat, etc. He excavated at Purana Quila in Delhi and Mathura in Uttar Pradesh.

Munish Chandra Joshi has published more than 200 research papers on Indian art, architecture, culture and archaeology including theoretical issues and concepts. His writings, whether in English or in Hindi are marked by a deep understanding and are full of insight and original ideas. Though he has written several guide books on different monuments, only one – *Dig* has been published by the ASI.

Munish Chandra Joshi had travelled extensively and visited China, Hong Kong, Egypt, UK, USA, Germany, Russia, France, Portugal, Italy, Nepal, Bhutan, Bangladesh, Sri Lnaka and Pakistan in connection with seminars and conferences, as a leader/member of Indian delegations or to deliver lectures. He was associated with several universities and other academic institutions as a distinguished scholar and visiting professor. He was the commissioner for the exhibition "The Golden Age of Classical India- The Gupta Empire" held in France.

Munish Chandra Joshi's death has left a void that cannot be filled. For his friends and colleagues, it is a great personal loss and for me, I have lost my mentor and guide.

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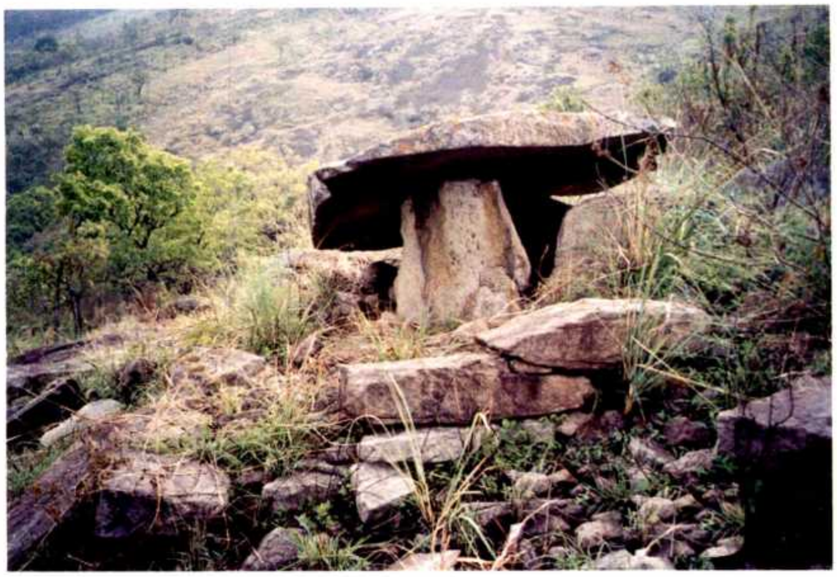
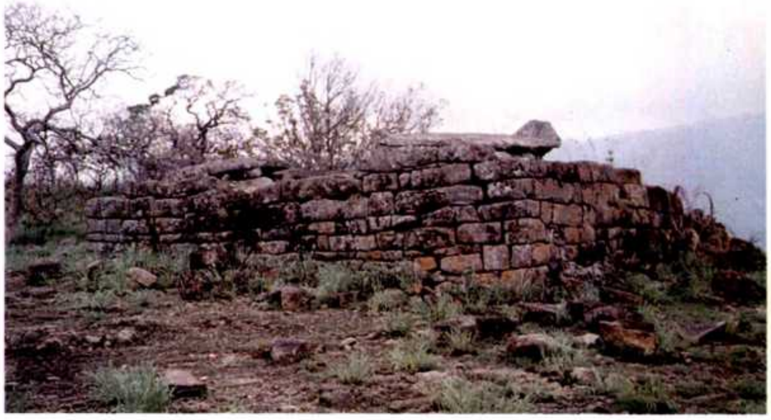


Fig. 2: General view of Dolmen



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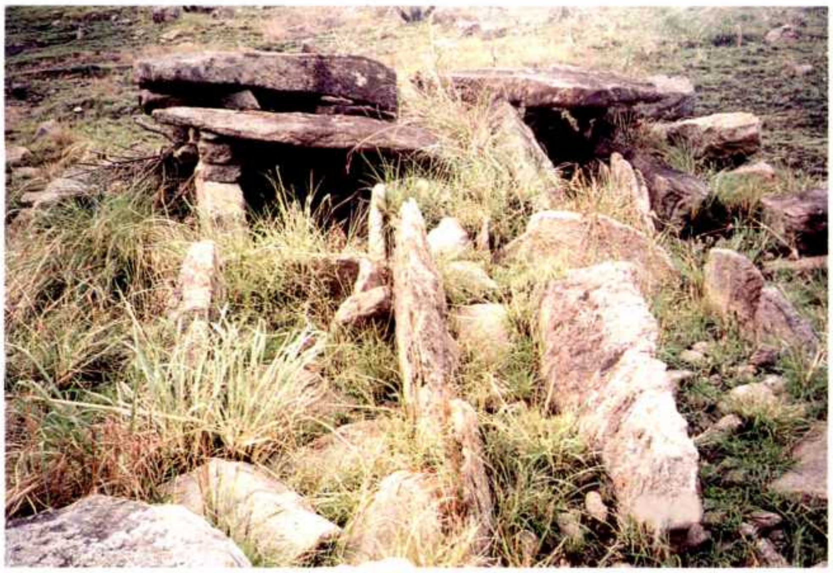

Fig. 4: Dolmen with double capstone, Kottailkal-teri, Tamil Nadu

R.N. Kumaran and M.S. Kumaran, *Man and Environment* XXXII(1): 46-56 [2007].
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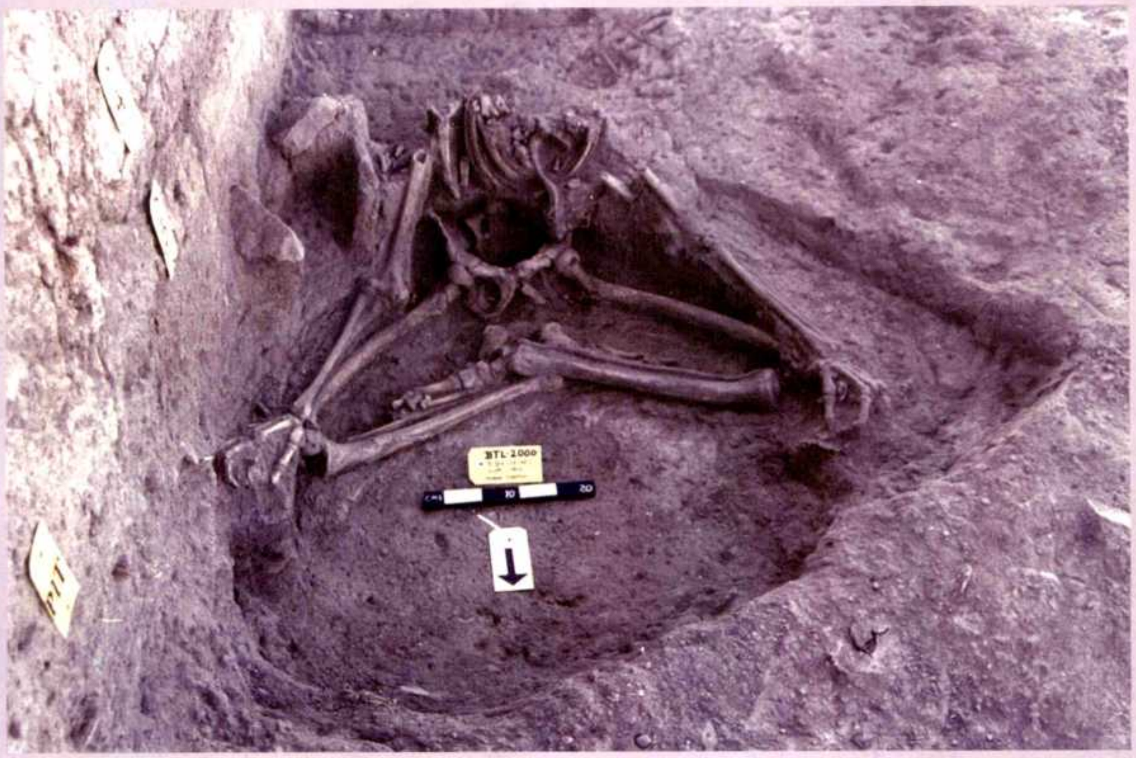
Publisher
Indian Society for Prehistoric and Quaternary Studies
c/o Department of Archaeology
Deccan College, Pune 411 006

Printers
Mudra
383, Narayan Peth
Pune 411 030

Price: Rs. 600.00

Vol. XXXII, No. 2, 2007

Man and Environment



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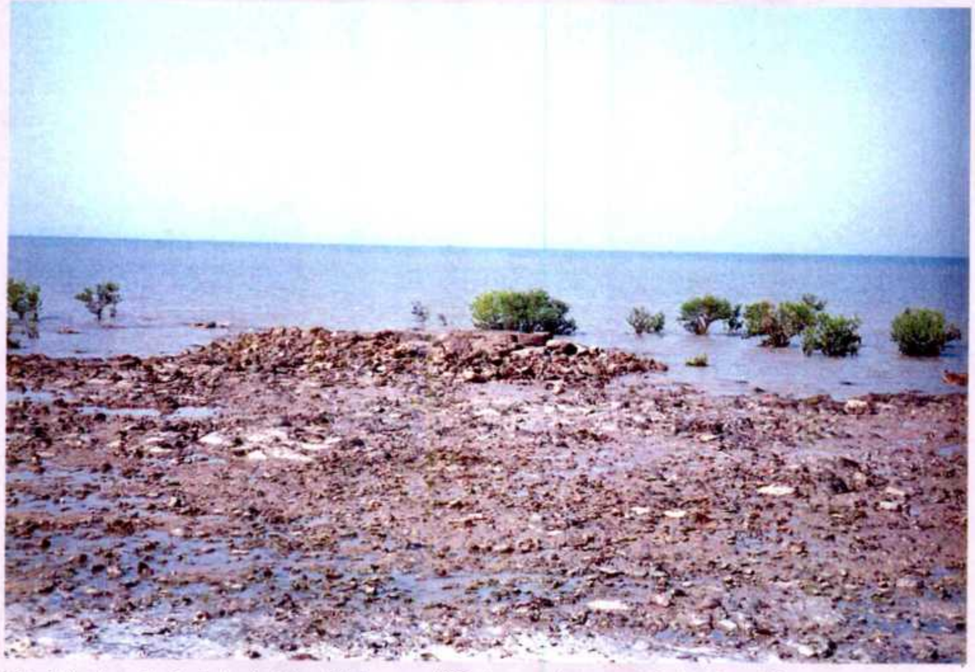

Fig. 3 Archaeological site in inter tidal zone of Pindara and exposed during low tide.

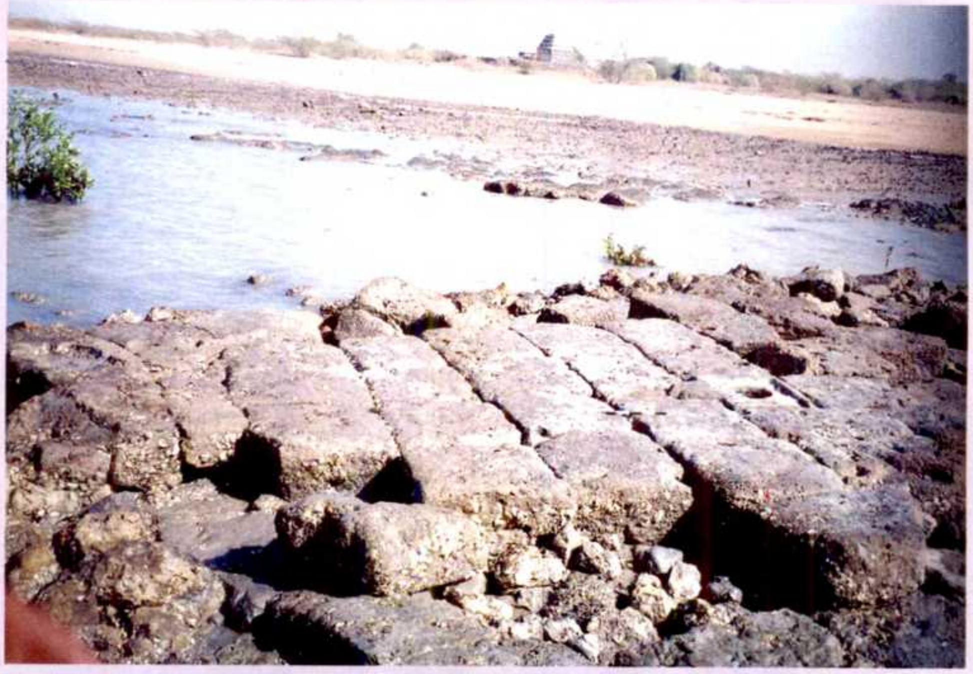

Fig. 5 Remains of a temple complex exposed during low tide

A.S. Gaur, Sundaresh and Sila Tripati,
Man and Environment XXXII(2): 37-40 [2007].
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Man and Environment

Journal of the Indian Society for Prehistoric and Quaternary Studies

Editor: V.N. Misra

Joint Editors: P.P. Joglekar
Shanti Pappu

Editorial

This issue of the journal contains five papers all of which deal with protohistoric and early historic periods.

Gwen Robbins and her associates have studied the skeletal material from the Chalcolithic and Early Historic site of Balathal in Rajasthan. These authors had earlier published a study of the pathological traits of these skeletons in one of the previous issues of the Journal. The present paper gives a detailed account of the stratigraphic context of the burials, measurements undertaken on the bones and teeth, and an inventory of the entire material.

Benudhar Patra gives an account of the Early Historic urban centres of Western Orissa. A.S. Gaur and his colleagues report their discovery of a submerged temple complex near Pindara on the northwestern coast of Saurashtra. It will be interesting to know whether the temple complex was submerged due to subsidence of land or rise of the sea level. P.K. Behera and his colleagues have reported radiocarbon dates from the middle Mahanadi valley in Orissa. These dates throw light on the age of the early cultures of this region. Chinmoy Chakrabarti and his colleagues have examined the geomorphological background of the growth of the well-known early historic settlement of Chandraketugarh in West Bengal.

S.V. Rajesh and Ambika Patel have compiled a gazetteer of the prehistoric and protohistoric sites of Gujarat. One hopes that other researchers will emulate their example and compile similar gazetteers for other regions so that we will get a proper picture of the distribution patterns of the ancient cultures and the role of geographical factors in these patterns.

We again regret to note that there is not a single paper on Stone Age prehistory in this issue. This confirms our observation in the editorial of one of the previous issues that prehistoric studies in India have sharply declined in recent years. We sincerely hope that the heads of archaeology departments in the universities and other institutions will encourage their students and colleagues to undertake research in this important branch of archaeology.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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Cover: Human skeleton from Balathal, in yogic posture © Deccan College, Pune.

G. Robbins, *et al.*, *Man and Environment* XXXII(2): 1-25 [2007].
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Human Skeletal Remains from Balathal: a Full Report and Inventory

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Abstract

The small assemblage of human remains from Balathal (5 adult individuals) represents the first collection of human remains to be published from the Ahar Culture of Chalcolithic and Early Historic Rajasthan. This paper provides a complete inventory, description, age and sex estimates, and measurements for the adult human skeletal and dental remains. Pathological conditions are described and interpreted in a previous article (Robbins *et al.* 2006).

Archaeological Context

The Chalcolithic period in India is broadly defined by the presence of copper and distinctive ceramic types in association with an economy based on agriculture, some pastoralism, and occasional supplementation with hunting and fishing. The period was regionally diverse and excavations of sites belonging to the Ahar culture are distinguished from Deccan Chalcolithic sites in material culture and mortuary practice. The Deccan Chalcolithic has been the focus of majority of excavations and processual investigations, including biocultural research on the large collection of human remains from this period located at Deccan College Post-graduate Research Institute. Even though it has not been intensively investigated, there are over ninety Chalcolithic sites that have been identified in the Mewar region of Rajasthan in Northwestern India, most of which are located in river valleys in the districts of Udaipur, Chittaurgarh, and Bhilwara (Misra *et al.* 1995). Only five of these sites – Ahar, Gilund, Balathal, Ojiyana and Lachura – have been systematically excavated thus far (Misra *et al.* 1995; Meena and Tripathi 2001, 2002).

Most of our information concerning the Ahar culture derives from excavations at the type site of Ahar, which spans the late third to the middle of the second millennia B.C. Gilund has contributed less information to date as the site was only excavated for one season in the 1950's but recent investigations undertaken by V.S. Shinde and G.L. Possehl should provide additional insights on this period of prehistory of the Eastern margins of the Thar desert. Ahar and Gilund yielded no human skeletal remains and thus Balathal represents the first opportunity to examine biological characteristics, biocultural adaptations, paleopathological profiles, and affinities of human remains from the Chalcolithic period in this region.

The Ahar culture, as the cultural sequence from 3500-1500 B.C. became known, is in part defined by a ceramic assemblage including Black and Red ware, sometimes with white painted designs, thin red ware with incised designs, bright red slipped ware, grey ware with incised or painted designs, and tan ware (Misra *et al.* 1995). The tan ware has been interpreted as having affinities with the Late Harappan ceramic types in terms of the clay fabric and the vessel forms (Misra *et al.* 1995). Beads of carnelian, agate, terracotta and steatite, terracotta figurines, and copper implements comprise the rest of the cultural material. In contrast to the Deccan Chalcolithic, few stone blades or microliths were recovered from Chalcolithic deposits at Ahar. The structures at Ahar were constructed of stone and mud, those discovered at Gilund are of sun-dried and occasionally burnt brick, which has also been interpreted as demonstrating a relationship with Harappan civic planning (Misra *et al.* 1995). The Chalcolithic elsewhere in India, including Maharashtrian sites such as Inamgaon, is represented only by wattle and daub construction methods (Misra *et al.* 1995).

The site of Balathal (24° 43' N; 73° 59' E), discovered by V.N. Misra in 1964, is located approximately 40 km northeast of the modern city of Udaipur and 6 km south of Vallabhnagar village (Fig. 1). The site consists of one mound of occupational deposit estimated to have originally covered approximately 165 m (NE-SW) by 155 m (E-W). Agricultural activities have destroyed the periphery of the site, which now covers an area of 90 m (N-S), 80 m (E-W) and 7 m in height (Misra *et al.* 1995). Much of this mound, east of the modern village of Balathal, was excavated over seven seasons, from 1994 to 2000. The periphery of the site was damaged in the process of modern cultivation of cotton, sugarcane, wheat, and mustard but the majority of

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Received : 19-11-2006
Revised : 2-6-2007
Accepted : 7-8-2007

Table 1: Select Radiocarbon dates from Balathal (For complete list see V.N. Misra 2005)

PRL No.	Trench (Layer)	Depth (m)	Radiocarbon Age (in years BP)
1933	OE (23)	4.98	5770 ± 100
1928	HX2 (18)	4.68	4550 ± 180
1834	OD (10)	4.00	4350 ± 70
1846	HX2 (14)	3.16	4310 ± 80
1844	HX2 (12)	3.27	4300 ± 80
1843	HX2 (11)	2.83	4120 ± 70
1937	OB (16)	2.05	3980 ± 90
1835	F4 (7)	3.17	3830 ± 60
1925	HX2 (15)	3.80	3810 ± 170
1930	OE (21)	4.71	3760 ± 110
1850	C1 (2)	0.47	3530 ± 70
1851	B4 (4)	1.40	3510 ± 70
1849	C (3)	0.90	2290 ± 70
1841	HX2 (3)	0.84	2110 ± 60
1848	C (2)	0.50	1820 ± 70

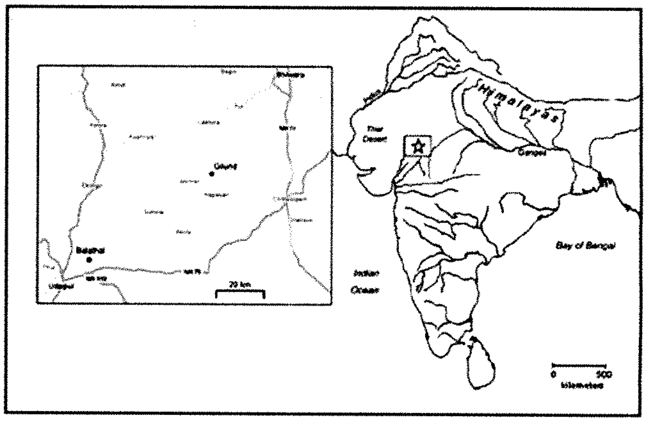

Fig. 1 Map of India showing the location of Balathal

the mound was left intact (Misra *et al.* 1995). The average annual rainfall in this region is 750 mm and winter crops are supplemented with well water. There is no permanent river or lake near the site, though there is a natural depression (about 1 km in length and width) the drainage from which currently replenishes wells in the vicinity in the monsoon season and creates a deposit of silt used in agriculture (Misra *et al.* 1995). Wild bushes and trees include *Capparis decidua*, *Prosopis spicigera*, and *Acacia arabica*.

The Chalcolithic period at Balathal (5500-4400 BP) has been divided into two successive phases. Radiocarbon dates are provided in Table 1. Phase A of the Ahar culture) is represented by approximately 1.50 m of cultural deposit (Layers 10-23) and is found in all but the southern part of the site (Misra *et al.* 1997-98). Circular mud, mud-brick and stone residential structures, coarse handmade plain or painted ceramics, and a scarcity of stone blades typify this phase (Misra 1997). Copper fragments and semi-precious stones are occasionally found in this period as well (Misra 1997). There were no burials located within this older deposit. Phase B (4400-3800 BP) represents a dramatic transformation in the material culture and the architecture of the site (Misra 1997). In this period (Layers 6-9) also residential and other structures were constructed of stone, mud, and mud brick (Misra 1997). The pottery is wheel thrown and was fired within the kilns located in the residential complex at the southwestern end of the site. There is an increase in the distribution of copper implements and material culture for this period in general (Misra 1997). Three burials were uncovered within layers from this period (Table 2).

During Phase B a large enclosure (c. 600 m^2) of stone, mud and mud mortar was constructed the centre of the settlement. The stratigraphy within the enclosure is different from that of the external areas of the mound. Here layers 6-12 were mainly composed of burned cow dung and vitrified ash sloping from north to south. The ash has been interpreted as representing the product of the burning of cow dung. The deposit is stratified and was produced *in situ*.

Sealing the Chalcolithic deposit is a sterile layer (layer 5) of homogenous black clay, 40-100 cm in thickness, overlying a thick base of angular stones. The layer is thickest south of the fortified enclosure and it gradually thins toward the north. Despite the designation as a sterile layer, this deposit is not absolutely sterile; there is minimal material consisting of faunal remains and a few potsherds. The ceramics are from the Early Historic in the uppermost part of the layer and from the Chalcolithic in the lower part of the layer. The stones forming the base of layer 5 are interpreted as structural material from the Chalcolithic phase, which was displaced during the millennium in which the site was abandoned. Once the Early Historic occupants arrived, they may have brought this dark soil from surrounding fields to level the surface of the mound for reoccupation.

The sterile layer is followed by deposits from the Early Historic Period (2300-1800 BP), comprised of the first three layers of the mound as well as a small deposit in the southernmost region of the mound. The Early Historic layers in the main mound were separated from the Chalcolithic and the sterile layer by a layer (4) of compressed white ash 20-25 cm thick. This layer thins and disappears in the southern part of the mound. Iron-smelting

Table 2: Burial Provenience

Ind	Date	Trench	Quadrant	Layer	Depth	Orientation	Posture
1997-1		E3	NE	7	2.66		flexed, on left side
1997-2	20/12/1997	A6	SE	3	1.07		comingled with 1997-1
1999-1		E4					flexed, on right side
1999-2	28/1/2000	B4	SE	5	1.65	facing South	seated, hands on knees
1999-3	8/2/2000	D4	NE	6			

technology, plain red and grey ceramics, copper coins, beads of terracotta and semi-precious stone, animal and human figurines, seals, and wattle and daub residential structures (Misra 1997) characterized the Early Historic period. Faunal remains of domesticated animals and charred grains of urd and moong were also recovered (Misra 1997). Skeletons of two individuals were recovered from the Early Historic period.

Chronology (Table 1)

Forty-five radiocarbon dates, all obtained on charcoal samples, are available for Balathal, – 23 from the Physical Research Laboratory (PRL) Ahmedabad, and 22 from the Birbal Sahni Institute for Palaeobotany (BIS), Lucknow (Misra 2005). The dates from the two laboratories are remarkably consistent. Fourteen of them come from the early historic layers (1-4), one from the sterile layer (5), and the remaining 30 from the Chalcolithic layers (6-23).

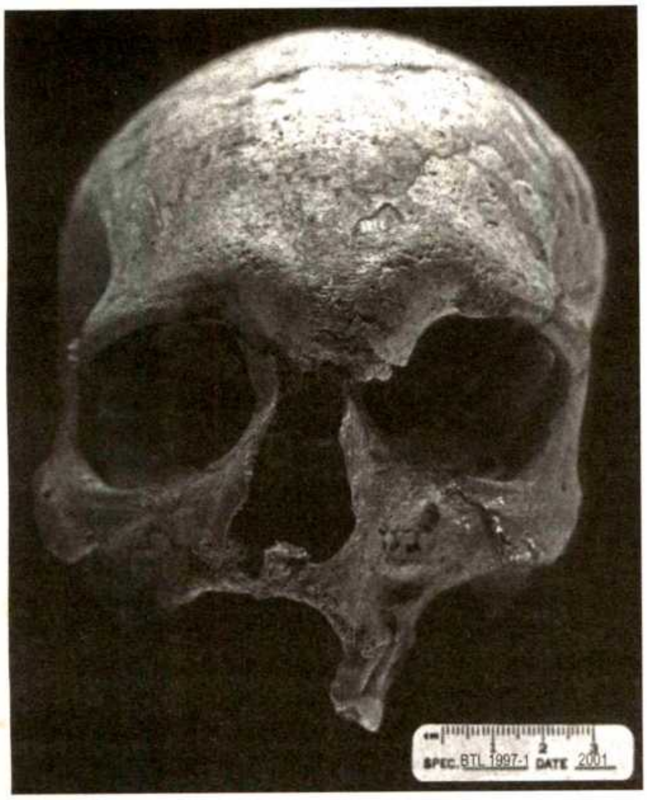

Fig. 2 BTL 1997-1 skull (ventral view) from an individual buried underneath many layers of cow dung within the 'fortification area.'

Of the thirty dates from the Chalcolithic layers, 25 are fairly homogeneous and stratigraphically consistent. In their uncalibrated form they range from 3020 ± 90 B.C. to 1810 ± 110 B.C., and in calibrated form 3700-3620 to 2200-1830 B.C. None of these 25 dates is younger than 1800 B.C.

The oldest dates, i.e. older than 2400 B.C. (uncalibrated), and 3500 B.C. (calibrated), come from trenches E-4 and HX-2, located in the northern and western part of the mound. These are given in Table 2.

These dates suggest that the earliest occupation at the site took place in the northern and western parts of the mound. Five dates fall outside the ranges of both uncalibrated and calibrated dates. Three of them are too early and two are too late. The too early dates are: 1. BS-1796. 4540 ± 120 B.C. (uncalibrated) and 5460-5080 B.C. (calibrated); 2. BS 1742. 4330 ± 120 B.C. (uncalibrated) and 5230-4610 B.C. (calibrated); and 3. PRL 1933. 3820 ± 100 B.C. (uncalibrated) and 4540-4340 (calibrated). The two too late dates are: 1. PRL 1981. 650 ± 90 B.C. (uncalibrated) and 800-410 B.C. (calibrated), and 2. BS-1783. 390 ± 100 A.D. (uncalibrated) and 420-640 A.D. (calibrated). These errant dates have not been taken into account in fixing the chronology of Balathal. As both the Chalcolithic skeletons come from the deposit of Phase B, they belong to the period 2400-1800 B.C.

Of the 14 dates from the early historic period (layers 1-4), nine come from layer 3, the richest layer, two each from layers 2 and 4, and one from layer 1. Ten dates are homogeneous and stratigraphically consistent In their calibrated from they range from 570 ± 70 B.C. to 130 ± 70 A.D. and in calibrated form from 760-400 B.C. to 130-380 A.D. The uncalibrated dates seem to represent a more realistic picture of the chronology of the early historic period. The remaining four dates fall outside these ranges and all of them are too early for the Early Historic period.

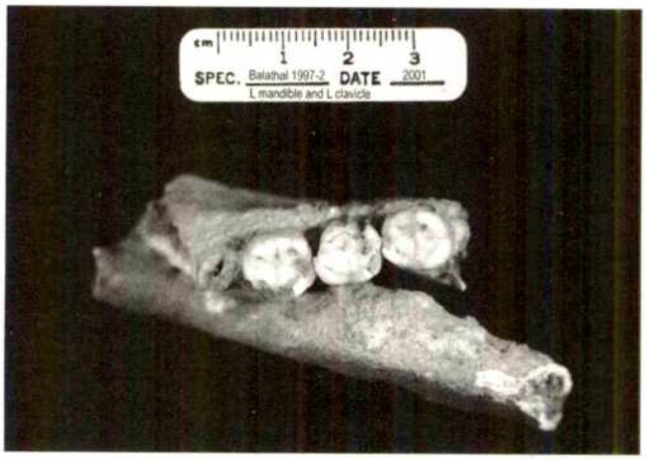

Fig. 3 BTL 1997-2 remains consist of a L mandible and L clavicle, comingled with remains of BTL 1997-1 (occlusal view of M1, M2, and M3)

Considering the consistent dates one can say that the Early Historic period dates between sixth century B.C. and fourth century A.D. This dating is also consistent with the pottery, a few terracotta human figurines, and a couple of terracotta seals bearing Brahmi letters. The skeletons therefore date from this period. None of them is dated directly.

Burial Context and Orientation

During excavations of Ahar and Gilund, no skeletal material was uncovered and the expectation for excavations at Balathal was that there would also be no human remains uncovered as there was no evidence of a proper cemetery. Unlike the Deccan Chalcolithic there was no precedent for burial of children under house floors. During the 1997-1998 field season one burial was uncovered in an ash deposit within the stone enclosure. During the 1999-2000 season three additional burials were uncovered. There was no evidence of formal burial pit or grave for any of these burials and no additional individuals were uncovered despite the extensive excavation of the site.

During the 1999-2000 field season one individual that had been interred in a position reminiscent of *samadhi*, was damaged during a landslide of the excavation wall. Gwen Robbins was requested to reconstruct this individual upon a visit to the site in February of 2000. The remains from this individual were also described in the field. The remaining material was examined and described by G. Robbins and V. Mushrif, under the guidance of Dr. S.R. Walimbe, in the laboratory at Deccan College Post-Graduate Research Institute in 2001.

Anthropological analysis was employed as a means to gain insight into the health and physical characteristics of the Ahar Culture people who lived at Balathal. Human remains have not been recovered from the other four Ahar culture sites (Ahar, Gilund, Ojiyana and Lachhura) that have been investigated so far. Although the sample size is small and all conclusions based on it must therefore remain tentative, the remains from Balathal represent the only opportunity to understand the biocultural record of this important period in the prehistory of Rajasthan. Obviously, such a small sample precludes many biocultural research questions involving paleodemography, epidemiology, and/or studies of human adaptation and this type of analysis will be limited by the nature of the sample.

Anatomical description and anthropological study was undertaken at Deccan College Post-Graduate Research Institute, Pune. The remains are extremely fragile, with little of the organic component remaining. All of the skeletal remains were coated with adhering calcareous matrix and preservative. The remains were cleaned although in some cases it was not possible to remove the soil without causing further damage to the material and this occasionally presented a hindrance to palaeoanthropological analysis. The dental enamel in general was well enough preserved to allow detailed study, however in a few cases even the dental remains were fragmentary and the enamel was damaged. The numbering system used here is based on the date of excavation and the order of discovery, e.g. 1997-1 indicates that individual was recovered in the 1997-98 season and it was the first individual recovered during excavations in a chronological sense.

Upon investigation of the remains uncovered during the 1997-1998 field season, it was discovered that there were two individuals co-mingled in this package. The remains of these two individuals (1997-1 and 1997-2) had been fully excavated from the surrounding soil, packed, and stored at Deccan College until the present investigation. Burial 1997-1 was exposed in layer 7 of the northeast quadrant of trench E3 at a depth of 2.66 m (Fig. 2). The burial was located within the layers of cow dung inside the fortification walls and no grave outline was observable during excavation. This individual was interred in a tightly flexed, almost foetal position, resting on the left side. Taphonomic processes have destroyed most of the organic component in the bones, which are fragile but the individual is fairly complete (see inventory, Table 3).

Burial 1997-2 was exposed on 20/12/1997 in the SE quadrant of Trench A6 in layer 3 at a depth of 1.07 m (Fig. 3). This individual is currently represented only by nine cranial fragments, a left mandible and left clavicle. These are the minimum number of remains from this individual, which were separated on the basis of duplication of remains from 1997-1. The very fragmentary and incomplete remains from this burial were co-mingled with those of 1997-1 and it is possible that some of the 200 bone fragments (less than 1 cm in length), packed in bags labelled as 1997-1, may actually belong to this individual.

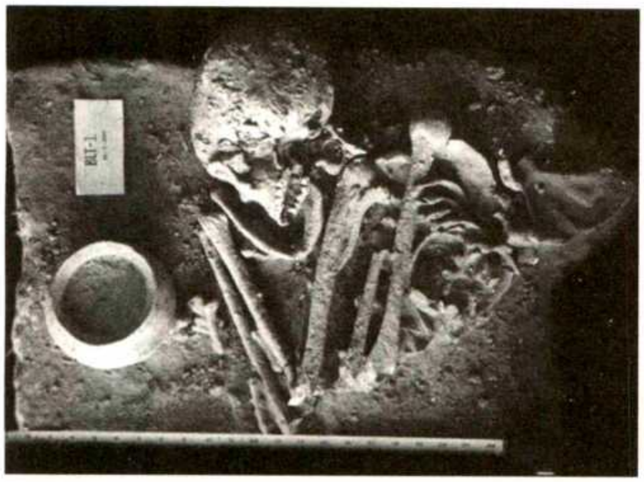

Fig. 4 BTL 1999-1 individual demonstrates careful burial treatment, deliberate posture of the body, and grave goods (plan view). Skeleton demonstrated no evidence of pathology (Robbins *et al.* 2006).

Individual 1999-1 was uncovered in trench E4 (Fig. 4). This individual is well preserved and the upper half of the skeleton is fairly complete. However, the remains from below the thoracic region are missing entirely. This individual was buried in a flexed position, resting on the right side. There was a small *lota* (globular pot) above and to the left of the skull. This pot represents the only evidence for grave goods at Balathal.

One individual (1999-2) was buried in the sterile layer (5) outside of the walls north of the fortification structure (Fig. 1999-3). This individual was excavated on 28/1/2000 in the SE quadrant of trench B4, layer 5 at a depth of 1.65 m. The base of layer 5 is covered with a layer of angular stones and this skeleton was resting 10-15 cm above that platform. This burial did not intrude into layer 6. No burial pit outline was observed in the upper layers. The sterile layer (5) is dated to *c.* 3800-2600 BP. This individual was buried facing northwest in a seated position resembling a yogic posture. The legs were crossed, left over right, and the hands were placed on the knees. The fingers of the left hand were positioned with the terminal phalanges of the hallux and index finger touching. The phalanges of the right hand were slightly more open.

Individual 1999-3 was excavated on 8/2/2000 from the NE quadrant of trench D4 in layer 6. This individual was also relatively complete though again the bones were fragmentary and fragile. The provenience, burial posture, orientation, and relative chronology for the burials are provided in Table 2. The remains were inventoried and described according to procedures in Standards for Data Collection (Buikstra and Ubelaker 1994). Age and sex estimations, skeletal morphology and pathology, and analysis of the gnathic and dental remains are provided in separate sections below.

Age Estimation

The most serious problem facing bioarchaeological research on age estimation and paleodemography is the large amount of error associated with conventional adult age estimation methods (McCaa 2002). Any relative standard for age estimation based on macroscopic examination of relative morphological changes is biased by the cultural and biological differences between reference and sample populations, individual variability, and large margins of error. Unless a chronometric method is used, such as cementum annulations, multiple lines of evidence for age at death must be used to converge upon more accurate estimates. For this analysis, age was estimated using standards for dental attrition (Brothwell 1981) and attrition was reported using Scott (1979) for the anterior teeth and Smith (1984) for the posterior teeth. Age was also estimated using postcranial epiphyseal fusion (Buikstra and Ubelaker 1994), pubic symphysis morphology (McKern and Stewart 1957), and cranial suture closure (Todd and Lyon 1924) according to the elements preserved.

Standards for dental attrition are among the most commonly used methods for estimating age at death for adults. Miles (1962) and Brothwell (1981) were used in this study to estimate age at death based on molar wear rates. There are multiple causes for inconsistencies in individual dentitions as well as between sample and reference populations including age, sex, diet, occlusal patterns, temporo-mandibular joint form, mineralization differences, bruxism, and cultural practices such as non-dietary uses of teeth (Hillson 1996). If attrition is to be used to estimate age at death, at least half of one jaw should ideally be available for study, careful consideration of context is warranted, and a population specific wear rate should be calibrated.

Methods based on pubic symphyseal morphology have correlations with known age ranging from 72% (McKern and Stewart 1957) to 49% (Ascadi and Nemeskeri 1970). Many of the methods based on the pubic symphysis (McKern and Stewart 1957; Ascadi and Nemeskeri 1970; Gilbert and McKern 1973; Suchey 1979; Katz and Suchey 1986; Brooks and Suchey 1990; Buckberry and Chamberlain 2002) have also been critiqued for mirroring the reference sample and for a strong central tendency (Bocquet-Appel and Masset 1982). This method requires the evaluation of several criteria, which must co-vary in order to assign an individual into a discrete age category. When the features vary independently, large margins of error must be used. When the pubic symphysis was used for age, the method was that developed by Todd (1920) and McKern and Stewart (1957).

Methods based on morphological changes in the auricular surface, such as Lovejoy *et al.* (1985), require the evaluation of several distinct features of the auricular

Table 3: Inventory for the skeletal remains (excluding dental and gnathic remains)

Bur. No.	Skull	Thoracic cage	Upper extremities	Lower extremities
1997-1	Most of the cranial vault is articulated, pm crushing on L side damaged the frontal (zygomatic and postorbital regions), parietal, temporal and sphenoid (at pterion). Frontal: some pm damage to cortical bone and slight breakage in L supraorbital region. Parietals: R, L pm damage to cortical bone near sagittal suture. Temporals: R petrous portion separate, zygomatic process broken pm, some cracking; L is crushed and fragmented, petrous portion present, zygomatic process broken. Occipital: damage around foramen magnum, condyle present separately, facet for sphenoid missing. Sphenoid: inferior portion damaged, greater wings present. Orbital wall and pterion region damaged. Nasals: lateral region of R present; L missing. Malars: R fairly complete, frontal process damaged. L damaged near maxillary suture, zygomat-ic and frontal processes. Hyoid: L side from greater horn to medial turbercle.	Ribs: vertebral ends (6 R and 9 L), sternal ends (2 R, 2 L, and 3 side indet.), 38 diaphyseal fragments (side indet). Cervical vertebrae: atlas (occipital condyles damaged, L inferior articular facet present); axis (some damage to the dens but otherwise complete); C3 in articulation with axis (R transverse process missing); C4 through C7 held in articulation by matrix: C4 (damage to R transverse process), C5 (missing spinous and R, L transverse processes), C6 (L neural arch damaged and R, L transverse processes missing), C7 (R, L transverse processes damaged). Thoracic vertebrae: 6 with transverse processes, each broken ventral to vertebral notch, centra missing (T2-T7?); 10 isolated centra, neural arches missing; 1 spinous process; 2 R and 2 L isolated transverse processes. Lumbar vertebrae: 5 fragments of centra; 3 isolated transverse process fragments; Sacrum: ala (R greater wing and superior apophysis), median part of C2-C5 present, lateral margins damaged pm, coccyx missing.	*Scapulae*: R complete, posterior half of glenoid fossa separate, superior margin of supraspin-ous process broken, acromion process present (pm damage); L present in 7 pieces (acromion process, ventral half of glenoid fossa, inferior medial margin, and 4 blade fragments). Humeri: R fragments of distal metaphysis and epiphysis with medial half of the trochlea and malleolus. Dorsal and lateral surfaces missing (including the olecranon fossa). L complete proximal epiphysis and shaft to superior half of olecranon process, distal epiphysis missing. Ulnae: R complete including olecranon process and radial notch, most of distal epiphysis, including lateral epicondyle (pm damage). L proximal epiphysis damaged, inferior half of lunar notch and anterior half of radial notch present. Radii: R only diaphysis from tuberosity to distal metaphysis. L complete, pm damage to head. Carpals: all R, L lunate, triquetral; Meta-carpals: all R & L, 9 phalanges (side indet), 2 terminal phalanges.	*Innominates*: R 2 blade fragments (auricular surface, anterior superior spine), pubis present with inferior $^2/_3$ of symphysis; L pm damage to medial and ventral surfaces, inferior-lateral margin of auricular surface visible, sciatic notch and dorsal half of acetabulum present. Femora: R, L heads present as 2 fragments, fovea capitus preserved on one fragment. R proximal $^1/_3$ of diaphysis present in 3 frag-ments below lesser trochanter. L more complete with portion of proximal epiphysis, head missing, superior and ventral aspects of neck damaged pm, trochanters present, distal epiphysis missing. Tibiae: R, L ½ of midshaft. L lateral condyle present as separate fragment. Fibulae: 4 shaft fragments from R,L. 18 long bone fragments which could not be conjoined. Metatarsals: all R, L medial and intermediate cuneiforms and one cuboid (damaged pm). 7 pedal phalanges.
1997-2	9 cranial flat bone fragments	L clavicle: mesial ½ of midshaft		

Bur. No.	Skull	Thoracic cage	Upper extremities	Lower extremities
1999-1	Skull is fairly complete and is articulated. Inferior portion of occipital suffered most damage, pm cracks in frontal (across middle of vertical squamous portion), parietals (R in four pieces, L damaged near squamous suture), temporals (R damage to squamous portion, L damage to petrous, squamous, and mastoid portions), occipital (foramen magnum damaged, condyles present separately). Sphenoid is complete. Both orbits are complete and intact, as are all of the facial bones. The R, L malars, nasals, maxillae, vomer, and palate are all complete. 4 cranial flat bone fragments (< 2 cm in length) present separately.	A block of bones adhering together by matrix cannot be separated, contains thoracic elements: manubrium (articular facets visible), 7 L rib fragments with vertebral ends, 3 cervical and 1 thoracic vertebrae. Ribs: 9 additional shaft fragments (< 3cm length). Cervical vertebrae: atlas complete except missing L transverse process; axis missing R, L transverse processes, C3 complete and well preserved, C4, 5, 6 (in matrix block) complete. Thoracic vertebrae: 1 L half of centrum, L transverse process and sup articular facet (in matrix block), 3 complete (pm damage to spinous processes), fragments: 1 centrum, 1 spinous, and 1 R transverse process.	Block of matrix contains the R scapula, clavicle, and humerus. Scapulae: R superior ½ present, supraspinous portion and inferior ½ blade broken; L supraspinous portion, medial end of acromion process damaged pm. Clavicles: R, L complete. Humeri: R pm damage to lateral ½ of proximal epiphysis, medial ½ of distal epiphysis, $^2/_3$ of head present; L medial ½ of distal epiphysis missing. Radii: R medial-ventral ½ of head with radial tuberosity, complete diaphysis separate; L proximal epiphysis, $^2/_3$ of diaphysis. Ulnae: R pm damage to olecranon process, L missing. Carpals: 3 (matrix). Metacarpals: 4 (matrix). Phalanges: 4 proximal and intermediate, 3 terminal	Missing
1999-2	Missing	Ribs: 11 fragments in situ. The surfaces are buried in matrix, no articular ends present. Vertebrae: ventral surface of the L-5 centrum is articulated with the ala of the sacrum, dorsal and superior surfaces are embedded in matrix. The lateral margins of the ala have been damaged but the bone appears to be otherwise complete. The first and second sacral elements are visible in situ.	Scapulae: R superior ½ of body present, adhering to acromion process, glenoid fossa and supraspinous area missing. Clavicles: R distal diaphysis present from midshaft, L missing. Humeri: R, L proximal ends missing, mid-shaft to distal epiphyses present. Radii: R, L complete. Ulnae: R, L in anatomical planar position, only ventral surface of proximal ½ is visible. Carpals and Meta-carpals: all R, all L. Phalanges: R, L I – III proximal and intermediate, R II terminal.	Innominates: R crest damaged, auricular surface in articulation with ala, sciatic notch visible; L acetabular region only; femoral heads articulated (R, L); ischia fragmentary, in matrix; pubes missing. Femora: R missing distal epiphysis, L distal epiphysis damaged, medial epi-condyle and patella separate. Tibiae: R proximal epiphysis damaged, L complete. Fibulae: R, L proximal ends damaged. Tarsals, metatarsals and pedal phalanges: all R, L.

Bur. No.	Skull	Thoracic cage	Upper extremities	Lower extremities
1999-3	Frontal: median squamous portion with frontal crest, superior margin of L orbit from supraorbital notch to zygomatic process, 2 additional squamous fragments; Parietals: R parietal eminence, portion of sagittal and squamous sutures, L in region superior to squamous suture, 4 fragments of cranial vault with impressions from meningeal vessels (probably parietal); Temporals: L with complete mastoid, external auditory meatus, missing petrous portion and mandib-ular fossa; 2 occipital fragments, with portions of internal occipital protuberance and sagittal sinuses.	Ribs: 7 R articulated shafts, 2 R vertebral ends in articulation with two thoracic centra, 6 L vertebral ends, 2 sternal ends (side indet), 40 fragments (< 5cm in length, side indet.). Cervical Vertebrae: 3 held in articulation, centra missing, articular facets present; 1 isolated L neural arch. Thoracic Vertebrae: 5 upper vertebrae in articulation (3 R and 1 L sup/inf articular facets, 2 with centra); 2 R upper transverse processes (with sup articular facets); 3 dorsal portions from middle-lower region held in articulation (with 2 sup articular facets, 1 L transverse process); 2 lower spinous portions fused in articulation; 5 separate spinous portions from lower region; 1 centrum fragment; 3 spinous processes; 1 vertebral arch; 1 articular facet fragment. L4 and L5 in articulation with sacrum (L4 damaged sup half missing, L5 complete). Sacral vertebrae: S1 L facet in articulation with L5; S2-S5 articulated, marginal portions missing, ventral surface damaged pm.	Scapulae: R missing; L glenoid fossa in articulation with humerus, superior third of lateral margin, acromion and coracoid processes present. Clavicles: R missing; L lateral third of diaphysis, epiphyses missing. Humeri: R diaphysis and distal epiphysis complete, proximal epiphysis missing (some pm damage to medial epicondyle, medial half of olecranon fossa and trochlea). L complete but tuberosities at proximal epiphysis missing (head articulated with scapula), distal epiphysis complete (pm damage to medial aspect of trochlea). Ulnae: R articulated with radius, ¼ of shaft present; L almost complete, epiphyses present. Radii: R articulated with ulna, ¼ of shaft present; L 4 fragments of diaphysis and distal epiphysis. Carpals: R, L capitate (L damaged pm); R hamate; L lunate & scaphoid. Metacarpals: 4 R (missing IV, I–V complete), 4 L (proximal half II; I, IV, V complete); Phalanges: 4 proximal, 3 intermediate, 1 terminal (side indet).	Innominates: R in 4 fragments including blade from anterior-superior spine posterior to iliac crest; blade fragment with auricular surface (with portion of ala attached), sciatic notch, iliac tuberosity missing; acetabular region (posterior lunate surface with femoral head articulated), ischial tuberosity; R pubic bone (ramus compete, symphysis present, broken at anterior obturator tubercle and ischial ramus). L pubic bone (ramus complete, broken laterally and inferiorly). Femora: R proximal epiphysis (pm damage on trochanters) and ½ of shaft (head separate in acetabulum); L midshaft only (about ½ bone's total length). Tibiae: R in 3 fragments-proximal epiphysis including condyles to metaphysis, midshaft, and distal epiphysis in articulation with distal end of fibula (tibia crushed pm); L shaft with both metaphyses. Tarsals: R, L navicular; R, L cuneiforms; R cuboid; L talus, calcaneus,; Metatarsals: 5 R, L; Phalanges: 11 (7 terminal).

surface, which are supposed to change relative to one another. However, in many individuals porosity, surface texture, and marginal changes appear to be independent in terms of age of onset and pace of morphological changes (Buckberry and Chamberlain 2002) and thus certain features must be privileged over others in the application of the method. As this weighting is not standardized, choices of individual researchers will vary. This leads to high levels of inter-observer error and increases the likelihood that 5 year age categories are inaccurate. See Buckberry and Chamberlain (2002) for a more detailed review of the problems associated with methods using the auricular surface.

The rates of cranial suture closure are constant across ethnic and gender classifications but they vary considerably within the individual stages of closure (following Todd and Lyon 1924 as presented by Ubelaker, 1989, 2nd edition: page 83). This method is used here for individuals suffering from poor preservation, despite reservations about the level of precision afforded by this method. Epiphyseal fusion of postcranial elements is the preferred methods for individuals in young adulthood. This method relies on developmental change, rather than degeneration and thus is considered extremely accurate, particularly when more than one element provides information on the state of fusion. Standards for epiphyseal fusion in long bones were derived from Buikstra and Ubelaker (1994).

BTL 1997-1

This individual is estimated to have been an adult aged 40 years (30-50) though actual age may be older. Four methods were used to estimate the age of this specimen: cranial suture closure (Todd and Lyon 1924), dental attrition (Brothwell 1981), pubic symphysis morphology (McKern and Stewart 1957), and degenerative skeletal pathological conditions.

The skull is incomplete, has suffered post-mortem damage, and many surfaces are covered with calcerous matrix and are thus not observable. The coronal suture is completely closed on the ectocranial surface from bregma to pterion on both the left and right side and is obliterated inferior to the superior temporal line on the right side. The endocranial surface is partially visible through damaged regions of the occipital and the suture appears to be obliterated from this perspective. The middle of the sagittal suture is not observable due to post-mortem damage and adhering matrix. The suture is fused but not obliterated near bregma and lambda. The squamous suture is partially fused but has suffered post-mortem damage on both the right and left sides. The lambdoid suture is also partially fused. The spheno-frontal suture is damaged post-mortem. The actual scores for the cranial suture closure measurements are presented in Table 4 according to the scale published in Standards for Data Collection (Buikstra and Ubelaker 1994).

The dental wear pattern can only provide a minimum age estimate as there is an extreme amount of antemortem tooth loss (AMTL) and this has necessarily affected the amount and distribution of attrition on the teeth remaining. The wear pattern yields an age of 30-40 years using the methods presented by Miles (1962) and Brothwell (1981). Attrition scores are reported in Table 5 using the Smith (1984) system for anterior teeth and the Scott (1979) system for molars.

All of the postcranial sutures available were fused including the ribs, scapula, humeri, radii, ulnae, metacarpals, phalanges, iliac crest, the left femur and left tibia.

Table 4: Cranial suture closure

Ecto-cranial suture	**1997-1**	**1999-1**
mid-lambdoid	2	3
Lambda	2	3
Obelion	2	3
anterior-sagittal	2	3
Bregma	3	3
mid-coronal	3	3
Pterion	3	3
composite score	S5	S6
Mean age (range)	50 (35-60)	55 (40-60)
mid-coronal	3	3
Pterion	3	3
spheno-frontal	soil, pm dam	3
inferior spheno-temporal	2	3
superior sphenotemporal	pm dam	3
composite score	N/A	S7
Mean age (range)	N/A	55+

The first sacral vertebra is damaged but appears to have been fused to the second sacral vertebra, which occurs around 30 years of age on average (Buikstra and Ubelaker 1994). Thus the postcranial fusion provides a minimum estimate of 30 years.

The form of the pubic symphysis indicates that this individual was in the late 40s/early 50s at the time of death (phase 10 in Todd 1920). The surface of the right pubic symphysis is smooth, the face rarefied, the ventral margin is eroded and there is some marginal lipping. Transverse billowing is degenerated and there is some porosity. These features give an estimate of 50 by Todd (1920). Scores for the auricular surface using the method developed by McKern and Stewart (1957) follow: dorsal demiface, ventral demiface and symphyseal rim all scored a 5 giving a mean estimate of 41 years. Age related changes to the auricular surface are not observable as only the inferior margin is preserved. The later age estimate is supported by the presence of osteophytic lipping in the spine, thorax, and almost all of the diarthrodial joints available for analysis.

BTL 1997-2

This individual is estimated to be approximately 25 (17-32) though age estimation is problematic as it must be based solely on the attrition pattern for three molars from the left mandible. The cranial fragments do not preserve

Table 5: Attrition scores

	1997-1		1997-2		1999-1		1999-2		1999-3	
	Max	**Mand**	**Max**	**Mand**	**Max**	**Mand**	**Max**	**Mand**	**Max**	**Mand**
Smith 1984										
RI1		5			5				5	2
LI1		5			5				4	
RI2		5				5				2
LI2		5			5	5				
RC		5				5				3
LC		5			5	5	5	5	3	3
RP3		6			5					2
LP3		8			5	5			3	3
RP4		8			5			4		
LP4	7				5	5			4	3
Scott 1979										
RM1					22	25		17		20
LM1	21				23	37		16	15	20
RM2	17				12			13		16
LM2					15	18				16
RM3		24			7	13				0
LM3				18		14				

any evidence of cranial stenosis. Attrition should ideally be assessed from a full complement of teeth as occlusal pattern, AMTL, and other variables may influence the amount and the patterning of wear. The attrition on these three molars was scored using the Scott (1979) system and age was estimated, using Miles (1962) and Brothwell (1981), to be in the upper end of the 17-25 age range.

BTL 1999-1

Age for this individual is estimated to be over 40 years (30-50) based on cranial suture fusion and dental attrition. The cranial vault is covered with a layer of calcareous matrix and most of the region surrounding the sutures is not observable. However, the inner table of the vault is observable through post-mortem damage to the occipital bone; the frontal and sagittal sutures were thereby assessed. The frontal and sagittal sutures are fused; the sagittal is completely obliterated.

The maxillary right lateral incisor and canine are missing but the rest of the maxillary tooth row is present. The mandibular central incisors, right third premolar and right fourth premolar were lost post-mortem. The right second molar was lost antemortem and the alveolus is resorbed completely. The rest of the mandibular teeth are present.

BTL 1999-2

Age at death for this individual is estimated to be between 30 years of age (20-40). The cranium is not present and all of the postcranial epiphyses are fully fused and obliterated, indicating an age range of middle adulthood. The auricular surfaces and pubic symphyses are present but are in articulation and thus not observable. Dental attrition provides the only means of estimating age at death with any specificity. Age was estimated to be 35-45 based on attrition using the Miles (1962) and Brothwell (1981) systems.

BTL 1999-3

This individual is estimated to have been at the lower end of the 30 and 35 year range based on cranial suture closure, dental attrition, and pelvic morphology including fusion of the sacrum and the pubic symphysis. Long bone epiphyseal fusion is complete and all the sutures are obliterated. Portions of the mid-sagittal and lambdoid sutures are present. The sutures were fused but not

Table 6: Age and sex estimation

Ind	Sex	Epiphyseal fusion	Dental attrition	Pubic symphysis	Auricular surface	Cranial sutures	Age estimate	Mean age
1997-1	M	>30	30-40	40-50		50	30-50	40
1997-2	-		17-25				17-32	25
1999-1	F?		35-45			55	35-55	45
1999-2	M?		25-35				20-40	30
1999-3	F	30-35	25-35	25-35	35	30-39	25-35	30

obliterated. According to Massett (1989), the degree of cranial suture closure indicates a 30% probability that this individual was in the age range of 30-39, a 25% probability that the age range was 18-29.

Dental attrition was scored using the Scott (1979) and Smith (1984) systems and age was estimated using Miles (1962) and Brothwell (1981) (Table 6). The amount of dental attrition indicates an age within the range of 25-35 and supports the lower end of the range of estimates from pelvic and skeletal maturation. The lower right third molar was given a score of zero as it was not in occlusion (Scott 1979).

The right and left pubic bones are present. Only the left bone was used in sex estimation as the right side is deformed by a healed fracture (see below). Some post-mortem damage and adhering matrix make assessment of the pubic symphysis difficult. Using the Todd system, the pubic symphysis falls within the 25-35 year range. This individual falls within the 22-40 age range (33 ± 7.75 years) according to the standard of McKern and Stewart (1957). Only the inferior 1/3 of the right auricular surface is visible but it appears to have a reduction in billowing and a granulated surface on the superior demiface, indicating an age of approximately 35 (Lovejoy *et al.*, 1985). The ala is fused to the second sacral vertebra but the suture is not obliterated, indicating an age of 30-32.

Sex Estimation

Sex was estimated for this sample using pelvic morphology (Bass 1995; White 1999; Pickering and Bachman 1997), mandibular morphology (Loth and Henneberg 1996), cranial morphology (Bass 1995; White 1999; Pickering and Bachman 1997), long bone lengths (Bass 1995; White 1999; Pickering and Bachman 1997), and skeletal robusticity. Measures of the long bone articular surfaces that provide sex estimates, such as the maximum diameter of the humeral or femoral head (Dittrick and Suchey 1986; Bass 1995; White 1999; Pickering and Bachman 1997) were not available for specimens 1999-1 and 1999-2 as these individuals remain in a block of soil. These methods were not necessary for 1997-1 and 1999-3 as pelvic indicators were available.

Standards for estimation of sex based on pelvic architecture are the most accurate given the strong selective pressure on pelvic morphology in terms of bipedalism and cepahalo-pelvic constraints of childbirth. In this study, we examined the shape of the pubic ramus, the sub-pubic angle, presence or absence of the sub-arcuate line, shape of the sciatic notch, and margins of the auricular surface.

Two mandibular traits, ramus flexure and gonial eversion, can discriminate male and female skeletons with a limited amount of precision though they should be used in conjunction with pelvic indicators if available (Loth and Henneberg 1996). The reliability of mandibular traits as independent indicators of sex is questionable (Loth and Henneberg 1996, 2000). Confounding factors include age and remodeling after tooth loss, which reduce the accuracy of these traits significantly. In a recent evaluation of this method in forensic samples of known sex, ramus flexure accuracy was only 66% for males, 32% for females, and 59% overall (Kemkes-Grottenthaler *et al.* 2002). The original scoring system assigns many individuals to the male sex. For gonial eversion, 75.4% of males and 45.2% of females were correctly assigned, with an overall accuracy of 69.3% (Kemkes-Grottenthaler *et al.* 2002). Intra- and inter-observer bias is also a problem. When these indicators were used in this study, the assigned sex is tentative unless pelvic indicators were also available.

Cranial morphology can also be used to estimate sex and the indicators used in this study are listed in Table 7 (adapted from Bass 1995; White 1999; Pickering and Bachman 1997). These estimators are less reliable than pelvic morphology and estimates based on cranial morphology in the absence of pelvic remains are considered tentative and should be viewed with caution.

BTL 1997-1

This individual is estimated to be male based on pelvic architecture, a determination supported by skeletal robusticity. The innominates are fragmentary but the

Table 7: Sex estimation from cranial morphology

Trait	Female	Male
supraorbital ridge/torus	less prominent	more prominent
upper edge eye orbit	sharp	blunt
eye orbit shape	rounded	square
palate	smaller	larger
teeth	smaller	larger
chin	rounded with V-shape	square, U-shaped
gonial angle	non-projecting	projecting or flaring
cranial vault	smaller, smoother	larger, rougher
frontal bossing	present	absent
parietal bossing	present	absent
muscle ridges (nuchal)	gracile	robust
zygomatic process	not expressed beyond zygomatic arch	expressed beyond zygomatic arch and beyond external auditory meatus as crest
mastoid process	smaller, short	larger, broad
occipital condyles	smaller	larger

regions surrounding the right and left auricular surfaces, the left sciatic notch and the right pubic bone (including the symphysis) are preserved. There is no pre-auricular sulcus and the sciatic notch is narrow, both indicating that this individual was male. The right pubic bone has a subpubic angle that appears to be narrow, and a rhomboid shaped pubic ramus. The medial aspect is broad and there is no ventral arc. Overall the bone appears to have a male configuration.

The supraorbital region is very robust for this individual, the glabella and mastoids are also quite prominent and the occipital crest and temporal lines are moderately developed. The overall robusticity of the cranium can be seen as confirming the estimate given by pelvic architecture. The mandible is gracile overall due to the advanced state of tooth loss and resorption; however the mental eminence is median and robust, also indicating male. The gonial angle is approximately 135°, the gonia are not everted, and muscle markings are gracile. While these indicators are often used to indicate female sex, Kemkes-Grottenthaler *et al.* (2002) have found that age and tooth loss can bias these indicators substantially and accurate sex attribution based on these indicators is only 59%. The gracility of the muscle markings and of the mandibular architecture is most likely a function of the extreme amount of AMTL that this individual suffered antemortem.

The length of the humerus is 350 mm and estimated stature is 178.25 ± 4.05. This humeral length supports the male sex designation (Bass 1995; White 1999; Pickering and Bachman 1997).

BTL 1997-2

Sex cannot be assessed with any confidence for this individual as the remains are so incomplete.

BTL 1999-1

No pelvic bones are available for this individual and sex estimation is based on mandibular architecture, skeletal robusticity, and postcranial measurements. The mandible has a short but stout architecture. The mental eminence is median and the gonial angle is approximately 135°. The gonia are not sharp nor everted. These indicators would suggest female sex; however individual 1997-1 demonstrated similar mandibular architecture yet the more diagnostic pelvic remains were clearly male. The cranial robusticity of 1999-1 would suggest female. The skull is gracile with small mastoids, a gracile supraorbital region with sharp everted orbital margin, receding forehead, medium-sized glabella, small square orbits, and small, receding zygomatics. Muscle relief at nuchal region of occipital bone is moderate and temporal lines are also only moderately developed.

The postcranial architecture is also gracile in terms of overall size, robusticity, and rugosity of muscle markings. The long bone lengths, circumference, diameters, and the estimated height for this individual resemble those of

1999-3, which had female pelvic architecture. The length of the humerus is 325 mm and estimated stature is 167 ± 4.45 (if female). This humeral length lies intermediate between the male and female averages (Bass 1995; White 1999; Pickering and Bachman 1997).

Other long bone measurements that are known to discriminate sexes with approximately 90% accuracy (such as the diameter of the humeral head (Dittrick and Suchey 1986; Bass 1995; White 1999; Pickering and Bachman 1997)) were not taken as this individual remains within an unexcavated block for display purposes and all long bones are in articulation. The maximum diameter of the femoral head and femoral bicondylar width were not measured for sex estimation (Ibid.) because the femora are not present. Thus this individual is tentatively assigned to the female sex.

BTL 1999-2

Most of the pelvic features for sex determination are not visible as the skeleton was left in matrix for exhibition in the museum. Only the superior margin of the right sciatic notch is visible but no estimate of the sex can be made with certainty based on the upper rim. Sex estimation will be based on postcranial measurements as the cranium was not present.

Based on estimated body size, skeletal architecture, and muscular robusticity, this individual is tentatively assigned to the male sex. Long bone measurements that are known to discriminate sexes with approximately 90% accuracy (such as the diameter of the humeral head (Dittrick and Suchey 1986; Bass 1987, 1995; White 1999; Pickering and Bachman 1997) could not be taken as this individual remains within an unexcavated block for display purposes and all long bones are in articulation.

BTL 1999-3

This individual is estimated to be female based on pelvic architecture and overall skeletal gracility. The preauricular region and the sciatic notch are present from the right ilium, the left pubic bone is present (the right was distorted by a fracture and was not used). There is a preauricular sulcus and the auricular surface is elevated, indicating female. The sciatic notch is broad, confirming a female estimate. The subpubic angle is broad, the pubic ramus is rectangular, and there is a ventral rampart inferior to the pubic symphysis. All pelvic indicators suggest that this individual was female.

The mastoid process is gracile and the supraorbital margin is sharp and everted rather than broad and robust. The postcranial skeleton is similarly gracile and muscle markings not pronounced. Long bone lengths, circumferences, and diameters are smaller than 1997-1 (male based on the pelvis) and more similar to 1999-1. The length of the humerus is 320 mm and estimated stature is 165.49 ± 4.45. This humeral length lies intermediate between the male and female averages (Bass 1987, 1995; White 1999; Pickering and Bachman 1997). Other long bone measurements that are known to discriminate sexes with approximately 90% accuracy (such as the diameter of the humeral head (Dittrick and Suchey 1986; Bass 1987, 1995; White 1999; Pickering and Bachman 1997) were not taken because pelvic remains were available for this individual. These factors combined may confirm the suggestion that this individual was female.

Description of Morphology and Pathology

BTL 1997-1

This individual has extensive lesions associated with osteoarthrosis, including the following diarthrodial joint surfaces: right and left glenoid fossae, left humerus (proximal epiphysis: head and trochanters), right and left ulnae (lunar and radial notches), left radius (distal epiphysis), the vertebral ends of the right and left ribs, left innominate (around the perimeter of the acetabulum), the right and left femoral heads, and the left tibia (lateral condyle). Vertebral osteophytosis (VOP) was noted on almost all of the available vertebral articular surfaces including the margins of the centra. In addition to osteophytic growth, this individual had a fracture in the left lunate that was in the early stages of healing and periostosis on the right tibia.

There is no evidence of porotic hyperostosis on the parietals, however there is some post-mortem damage and adhering matrix to the parietals near the sagittal suture that prevents secure assessment. There is no evidence of cribra orbitalia on the orbital roofs. The right external auditory meatus is visible and there is no evidence of exostoses. The right and left temporal glenoid fossae are observable and show no evidence of temporo-mandibular joint disease. There is a small fragment of occipital condyle present and it appears to be normal but the fragment is too small to judge pathological modifications confidently.

Marginal osteophytes and porosity were encountered on the articular surfaces of many of the diarthrodial joints available for analysis though the actual distribution of osteophytes is obviously skewed by the absence of many articular surfaces. The right and left scapulae are fairly complete but fragmentary. The posterior half of the right glenoid fossa is present and it has moderate marginal lipping. The ventral portion of the left glenoid fossa has moderate osteophytosis as well as some porosity on the articular surface.

There is no evidence for osteophytes or arthritic modifications on the right humerus, which is poorly preserved and only represented by two fragments of the distal metaphysis and epiphysis. Joint surfaces present on the epiphyseal fragment include the medial half of the trochlea, the ventral aspect of the medial malleolus, and the medial fossa. All of the dorsal and lateral surfaces are missing including the olecranon fossa and the medial malleolus. The left humerus is relatively complete but is missing the distal epiphysis. The proximal epiphysis is complete and there is moderate osteophytic growth on the ventral and dorsal surfaces of the head, mild osteophytes on the inferior margin of the head, the lesser trochanter, along the intertrochanteric line and on the ventral surface of the greater trochanter. The muscle markings on the humeri are moderately developed. There is no evidence of enthesopathy.

The right radius is represented by a complete diaphysis from the radial tuberosity to the distal metaphysis. The epiphyses are missing. The left radius is relatively complete except for some mild post-mortem damage to the lateral surface of the radial head and the medial surface below the head. There is no evidence of osteoarthritis on the proximal epiphysis. The radial tuberosity and muscle markings along the medial ridge are slightly more robust on this arm than on the right radius. The distal epiphysis is complete and there is some osteophytic development on the margins of the facet for the ulna and on the margins of the articular facets.

The right ulna is relatively complete including the olecranon process and the radial notch at the proximal end and most of the distal epiphysis, including the lateral epicondyle. There is some post-mortem damage to the dorsal and superior ventral aspects of the olecranon process. The lunar notch is present and free of arthritic conditions. The radial notch has some mild osteophytic growth on the inferior-ventral and the anterior-medial margins. The diaphysis is complete but the cortical bone cannot be observed due to adhering matrix. The distal epiphysis is present and complete; there is no evidence of osteoarthritic lesions on the articular surfaces. The left ulna is damaged at the proximal epiphysis and only the inferior half of the lunar notch and anterior half of the radial notch are present. There are mild osteophytes on the anterior-medial surface of the radial notch. The cortical bone on the shaft is damaged and periostitis cannot be assessed.

The left lunate is present and there is evidence of a partially healed transverse fracture. The fracture is a deep notch (almost severing the bone) running across the articular facet for the scaphoid. Within the groove there is osteophytic growth and woven bone visible, evidence that the healing process had commenced. The fracture is visible in radiographs as an area of reduced bone density. There is no evidence of osteoarthritis on the observable articular surfaces for any of the carpals, metacarpals, or manual phalanges.

Osteophytes were encountered on many of the articular surfaces of the costal elements and vertebrae. The thoracic cage is represented by the right and left first ribs, 6 right and 9 left ribs with vertebral ends, 2 right and 2 left ribs with sternal ends, 3 sternal ends side indeterminate, and 42 diaphyseal fragments. The tubercle, neck and head were examined individually, lipping and porosity scored separately using the scale in Buikstra and Ubelaker (1994): mild 1, moderate 2, severe 3. Osteophytes and porosity were observed on 21 facets out of 24 available on the vertebral ends.

The spinal column is relatively complete with elements represented practically from the atlas to S5. Almost every articular surface and central margin had some evidence of osteophytosis. Each articular surface was scored separately: the superior and inferior margins of the centra, the right and left superior and inferior articular facets, and for the thoracic vertebrae, the right and left costal facets (following Jurmain 1999). Thus each vertebrae had scores for 6-8 articular surfaces. The severity of the osteophytosis was scored following Buikstra and Ubelaker (1994). Mild lipping was given a score of 1, moderate 2, severe 3, and fusion 4. If the articular surface was absent it was left blank, if unaffected then scored as 0. Twenty-five articular facets, 38 central margins (superior and inferior), and 8 costal facets were affected.

The fourth through the seventh cervical vertebrae are present and held in articulation by matrix. The sixth cervical vertebra was compressed on the ventral surface. The fifth cervical vertebra has severe lipping on the right superior articular facet as well as on the ventral surface of the inferior margin of the centrum. The bone is in the process of fusing to the sixth vertebra, probably as a result of inflammation and dysplasia of the apophyseal surfaces.

The sacrum is not complete. The ala is only represented by the superior portion of the right greater wing. The second through the fifth sacral vertebrae are partially represented as the peripheral bone is missing and only the medial portion surrounding the neural canal is present. The vertebral canal is open below the third sacral vertebra and there are osteophytes on the spinous tubercles of the fourth and fifth sacral vertebrae.

The right ilium is represented by three pieces: a small fragment of the anterior-superior spine, and two blade fragments, one in the region surrounding and including the auricular surface. The right pubic bone is also present and includes the inferior 2/3 of the symphysis, the medial margin of the obturator foramen and the ischial ramus. There is no evidence of pathological modifications.

The left ilium is present but has suffered some post-mortem damage. The iliac blade has suffered a lot of post-mortem damage on the medial and ventral surfaces and only the inferior-lateral margin of the auricular surface is present. The margin is everted and has mild osteophytes but the rest of the surface is obscured by hard calcareous matrix and the bone is too fragile to remove it. The surface is not elevated and there is no evidence of a preauricular sulcus. The superior-lateral margin of the sciatic notch is present and appears to be narrow, though there has been some post-mortem damage. The dorsal half of the acetabulum is present and there are osteophytes along the perimeter. The articular surface is present and there may be some porosity on the surface though there is post-mortem damage precluding a secure assessment.

The right and left femoral heads are present as two fragments. There are marginal osteophytes on both, of moderate size. The fovea capitus is preserved for one of the fragments but it is heavily distorted by large osteophytes around the perimeter and porosity in the interior. The proximal third of the diaphysis of the right femur is present. The inferior margin of the lesser trochanter is present and the linea aspera is observable and moderately robust. The left femur is more complete. The proximal epiphysis is partially preserved though the head is missing and there is post-mortem damage to the superior and ventral aspects of the neck. The trochanters are present. The superior end of the linea aspera is observable but the rest of the surface is covered with adhering matrix. The muscle attachments are moderately developed. The distal epiphysis is missing.

The right and left tibiae are represented by approximately half of the mid-diaphyses. The cortical bone surfaces are not observable due to adhering matrix except for a small portion of the lateral aspect on the proximal right tibia. There is evidence of periostitis on this surface in the form of swollen and irregular cortical bone. The left lateral condyle is also present as a separate fragment. There are moderate marginal osteophytes on the medial margin. There are four diaphyseal fragments of the right and left fibulae present and 18 long bone fragments, which could not be conjoined. There was no evidence of pathological conditions on these fragments. The left medial and intermediate cuneiforms and one cuboid are present but damaged post-mortem. The five right metatarsals are present though they have also suffered damage to the articular ends. There is no evidence of osteoarthritis on the articular surfaces. Seven pedal phalange fragments are also present.

In association with the packed remains of this individual were 2-300 bone chips and fragments less than 1-2 cm in length that cannot be identified nor associated with certainty with any one individual. There were 20 fragments of burned and calcined animal bones in this assemblage. There were also 11 fragments of another individual (1997-2) packed in an additional bag with this burial.

BTL 1997-2

This individual is only represented by 9 cranial flat bone fragments, a portion of the left mandible, and the diaphysis of the left clavicle. The cranial bone fragments include 1 piece of the frontal including the frontal crest, one occipital fragment, and seven pieces of parietal bone. The left clavicle fragment is adhering to the mandibular fragment, both epiphyses are missing. There is no evidence of skeletal pathological conditions in the meagre remains for this individual.

BTL 1999-1

The skull and upper body are fairly complete but the skeleton below the thoracic region is missing. The pear-shaped skull is almost complete but suffered some damage post-mortem. Most of the bones are covered with a layer of calcareous matrix, which defies all attempts at removal without damaging the cortex. Thus porotic hyperostosis, cribra orbitalia, and temporo-mandibular joint conditions are not observable though the elements are present. The cranial sutures are also almost invisible due to matrix cover and wormian bones appear to be absent; however it is difficult to observe all regions. The external auditory meatus has no exostoses. The right and left occipital condyles are present as isolated fragments and the surfaces are free of matrix. There is no evidence of arthritic lesions on either condyle. The supra-orbital foramina is incompletely developed and orbits are bilaterally asymmetrical. The ascending ramus of the mandible is also asymmetrical with the right side much smaller than the left side.

The atlas is present and complete except for the left transverse process. The facets for the occipital condyles, the facet for the dens and the inferior articular facets are free from osteophytes. The axis is complete except for the transverse processes. There is a small depression on the inferior surface of the centrum, which corresponds to an incipient Schmorl's node that was in the process of developing on the superior surface of the third cervical centrum. The third cervical vertebrae is complete and shows no other evidence of pathological conditions or osteophytosis. There are three additional cervical vertebrae and five thoracic segments present and these show no evidence of pathological modification.

Articular surfaces were observable on the right and left scapulae, clavicles, humeri, radii, the right ulna, manubrium, and the vertebral ends of 15 ribs. These elements were relatively complete and only a few of the articular surfaces were damaged or missing. Many of the bones were within a block of matrix and the articular surfaces, though present, could not be examined. The articular surfaces which could not be observed include: the lateral half of the proximal epiphysis and the medial half of the distal epiphysis of the right humerus, the medial half of the distal epiphysis of the left humerus, the superior half of the lunar notch of the right ulna, the distal-medial half of the right radial head, the distal epiphysis of the left radius.

BTL 1999-2

Many of the bone surfaces, including most of the articular facets, are not visible as the skeleton was excavated in a block to preserve the unique burial posture. There are no cranial remains present for this individual except for isolated teeth. The axial skeleton is badly damaged but most of the bones of the upper and lower appendicular skeleton are complete.

There is no evidence of pathological condition on the visible surfaces of the upper extremities. The glenoid fossae are missing. The right clavicle is present but has been broken post-mortem near the midshaft. Eleven rib fragments are present in situ but there are no articular ends visible. The right and left humeri are both damaged, the proximal halves of both shafts are missing. The distal epiphyses are partially visible but the humeri are in articulation with the radii and ulnae. The ventral surfaces of the radii are observable including the radial head, diaphysis, and distal epiphysis. The right and left ulnae are positioned under the radii in the anatomical planar position and thus only the ventral surfaces of the proximal half of the bones are visible. The epiphyses and articular surfaces are not visible. The articular facets for the bones of the hands are not observable.

There is only one vertebral element visible. The ventral surface of the fifth lumbar vertebral centrum is visible and is in articulation with the ala of the sacrum. The dorsal and superior surfaces are embedded in matrix. The lateral margins of the ala have been damaged but the bone appears to be otherwise complete. The first and second sacral elements are visible in situ. There is no evidence of pathological conditions on these surfaces.

There is also no evidence of pathological conditions in the lower extremities. The pelvis as a whole is badly damaged and only fragments of the right and left ilia remain in situ. The femoral heads are in articulation so the articular surfaces are not observable. The right femur is fairly complete but the dorsal surface is embedded in matrix and not visible. The shaft is complete to the distal metaphysis, at which point the bone is broken and most of the epiphysis missing. The medial epicondyle and patella were present in articulation as a separate fragment. Only the superior and parts of the ventral surface are observable. The dorsal surface of the left femur is embedded in the matrix and is unobservable. The proximal and distal epiphyses remained intact and *in situ*, but are not observable. The distal epiphysis is not observable as it is buried in the matrix under the left hand.

The tibiae are present but damaged. The right medial condyle was present as a separate fragment. The distal epiphysis is presumably complete but is positioned beneath the left distal tibia and is not observable. The dorsal and lateral surfaces are embedded and are not visible. The proximal epiphysis of the left tibia is complete. The lateral condyle and the ventral half of the articular surface are clear of the matrix. The medial condyle is embedded. The distal epiphysis is in articulation with the calcaneus but the medial epicondyle is visible. The lateral half of the epiphysis is embedded.

The right fibula is damaged at the proximal end- the metaphysis is missing and only the epiphysis remains embedded in the matrix. The mid-section of the diaphysis is present but the dorso-lateral surfaces are embedded and not observable. The distal meta- and epiphysis are positioned under the bones of the left foot. The left fibular epiphyses are embedded and unobservable. The right calcaneus and talus are present and their medial surfaces partially visible. The feet remain *in situ* and appear to be complete though embedded in matrix. Some surfaces are visible for the left talus, calcaneus, cuboid, medial and lateral cuneiforms. The first, second and fifth metatarsals are present and visible. The phalanges for the first digit are visible; the rest are most likely within the surrounding matrix.

BTL 1999-3

This individual is relatively complete and exhibits several possibly inter-related pathological conditions. Five upper thoracic vertebrae were affected by severe osteophytosis and ankylosing. These elements demonstrate complete fusion of the ventral surface of the centra by ankylosed bone with a "candle wax" appearance.

This individual also suffered from three inter-related pathological conditions of the pelvic girdle. The left pubic bone has a completely healed fracture, there is evidence of luxation in the left acetabulum, and the left femoral head shows evidence of the initial stages of necrosis. The right pubic bone is also present and appears to be unaffected.

The left pubic bone was fractured on the inferior half of the pubic ramus, at the base of the ischio-pubic spine, in the region of the anterior tubercle on the margin of the obturator foramen. There is a large flat callous of well-healed bone overlying the ventral surface of the fracture, which is only visible on the medial and dorsal surfaces of the bone, and in x-rays (see plates – REF). The bone is broken post-mortem at the pubic ramus and the ischiopubic ramus. The amount of healing that has occurred indicates that the bone was fractured many years prior to death, though the exact number of years cannot be determined.

The inferior half of the left acetabulum is present and a new joint surface has been worn into the dorsal demiface. The femoral head was originally held in articulation with the acetabulum by matrix. Upon removal, the joint surface appears withered, possibly due to interrupted vascular supply and the initial stages of aseptic necrosis. The luxation of the joint surface due to mal-alignment resulting from the pelvic fracture, supports the inference that the fracture and resulting complications occurred many years prior to death.

There was no evidence of any infectious disease, metabolic or nutritional disturbance, or other pathological conditions in the skeletal collection from Balathal. Of the more complete remains, excluding 1997-2, one individual had no pathological conditions expressed in the skeleton and one additional individual (1999-1) had only an incipient Schmorl's node in the cervical spine. For individual 1997-1 (a 40 year old male) degenerative conditions associated with heavy labor (such as lunate fracture, osteoarthritis of diarthrodial joints, Vertebral Osteophytosis, vertebral compression fracture, and subsequent spondylosis) were manifest in the skeleton. This individual was either involved in heavy labor for a long period of time or he was particularly susceptible to bone forming responses to stress and could be called a "bone former" (Watt 1997). For individual 1999-3 (a 30 year old female), the presence of a compression fracture in the thoracic region, ankylosing of several thoracic vertebrae, a well-healed pelvic fracture of the anterior wall, subluxation of the acetabulum and necrotic femoral head indicates that this individual suffered from a traumatic fall, possibly from a great height, many years prior to death and was able to heal (Robbins *et al.* 2006).

Description of Pathology in the Dental and Gnathic Remains 1997-1

The majority of the maxillary teeth in this individual are missing due to ante-mortem tooth loss (AMTL) affected (see inventory, Table 8). The alveolar regions of both sides of the maxilla have been resorbed following tooth loss. There are small indentations where the sockets for RP3, RC, RM2, and RM3 had been, indicating that these teeth were lost more recently. Thus it appears that the left side of the mouth was affected by tooth loss earlier in life than the right side. There are two periapical abscesses with smooth edges along the buccal surface of the alveolar bone on either side of the left maxillary M1. This tooth, along with its neighbour (the left P4) are the only two teeth that remain within the jaw and the alveolus for both teeth has suffered from some resorption as well. The abscess suggests that they might have been lost soon had this individual not perished. The only other maxillary tooth present (as an isolate) was the right second molar.

The left P4 is worn and only a thin margin of enamel remains on the disto-lingual surface, the rest of the crown enamel has been obliterated from attrition. The left M1 crown is worn, with large dentine exposures on the mesiobuccal cusp and mesiolingual cusps. The two distal cusps have pin prick sized dentine exposures. The right M2 isolate suffered from a substantial amount of post-mortem damage to the enamel so LEH is difficult to evaluate, it appears that there may be a faint defect on the buccal surface. The mesio-buccal and lingual cusps are worn to small dentine exposures. There are interproximal wear facets on the mesial and buccal surfaces. There is pronounced hypercementosis on the root apices.

The mandible has a very gracile appearance overall owing to an extreme amount of AMTL and alveolar resorption. The muscle markings in the myelohyoid and gonial regions are gracile. The lower left P4, left and right M1, M2, and the left M3 were lost antemortem and the corpus is reduced to a thin bridge (11 mm in height) along the inferior margin between the anterior teeth and the ascending rami. The right P4 and M3 are the only posterior teeth present.

The anterior dentition is present *in situ*. For all of the anterior teeth, three-quarters of the root surfaces have been exposed by alveolar resorption, most likely the result of periodontal disease. Calculus deposits on the root surfaces half way from the CEJ to the apex, indicate exposure *in vivo*. The alveoli margins are rounded and the apices of the tooth roots are visible. The central incisors are worn to approximately half the original height of the crowns and only a thin rim of enamel surrounds the dentine exposures. There is some slight post-mortem damage to the enamel on the anterior labial surface of the crown. The second incisors are also heavily attrited, with the plane sloping both from buccal to lingual as well as mesial to distal. There is a brownish discoloration on the enamel surfaces.

Attrition has removed approximately ¼ of the crown surface of the lower right canine and there is a large dentine exposure. There is some post-mortem damage to the enamel surface of this tooth but there is an obvious LEH defect 2.81 mm above the CEJ on the buccal surface. There is a fainter, but still definite LEH defect at 4.70 mm above the CEJ on the buccal surface also. The occlusal surface of the left canine is worn in a sinuous outline, the mesial side higher than the distal. There is a large dentine exposure on the occlusal surface and secondary dentine formation is visible. There are two corresponding LEH defects at 3.05 and 4.51 mm from the CEJ on the buccal surface.

The right third premolar is heavily worn and half of the crown has been removed. There is a deep occlusal basin of exposed and subsequently worn dentine. On the distal surface, just below the CEJ, there is an incipient interproximal wear groove that is not related to interproximal tooth contact and may indicate some habitual behavior. The left third premolar has been even more heavily attrited to below the CEJ. The pulp chamber is exposed and though the dentine is serving as an occlusal surface, there is no secondary dentine sealing the pulp chamber. There is a periapical abscess on the labial surface of the alveolus for this tooth and the apex of the root is visible. The abscess is an opening 4.25 mm in width and 3.21 mm in height. The

Table 8: Inventory of dental and gnathic remains

Bur. No.	Gnathic Remains	Maxillary Teeth	Mandibular Teeth
1997-1	R maxilla: frontal process and lateral margin of nasal aperture; L maxilla: frontal process. Infraorbital regions present in both maxillae. Alveolar region present on both maxillae- R side missing posterior to M1 alveolus; L side missing posterior to M3. Palates preserved. Mandible fairly complete except for R ascending ramus damaged posteriorly, R condyle damaged, L missing. PM crack below RC.	All teeth lost ante-mortem except for 2 in situ and 1 isolate. In situ: L fourth premolar and L first molar Isolates: R second molar	In situ: R and L central incisors, R and L lateral incisors, R and L canine, R and L third premolar, R fourth premolar, R third molar. RI1 crown enamel damaged PM
1997-2	L mandible: portions of body from LP4 to LM3 but broken in pieces. LP4 and LM1 root stuck together on L clavicle, along with LM2 root fragment. Alveolus for LM3.	none	In situ: L fourth premolar root, L first molar, L second molar, L third molar Isolates: L second molar crown
1999-1	Complete maxilla and mandible present.	All teeth present and in situ, except for right lateral incisor and right canine (missing pm).	In situ: R and L lateral incisors, L canine, L fourth premolar, R and L first molar, R and L second molar, and R and L third molars. Isolated teeth include the L third premolar and R canine
1999-2	none	Isolated L canine crown fragment	Isolates: L canine, L and R fourth premolar, L and R first molar, L and R second molar
1999-3	A small piece of the alveolar portion of the left maxilla is present from L canine to L first molar. Most of the mandibular corpus is present in four fragments. Two adjoining fragments of the right mandible are present one from the lateral incisor to the fourth premolar. The other fragment retains the first and second molars. The left mandible is present from the third premolar to the second molar. Another small piece of the left mandible includes the left mandibular condyle and part of the ascending ramus. The sigmoid notch is broken.	In situ: L Canine, L third premolar, L fourth premolar, and L first molar Isolates: R and L central incisors, L third molar	In situ: R lateral incisor, R and L canines, R third premolar, R and L fourth premolars, R and L first molar, R and L second molars Isolates: L Canine and R third molar

superior margin is 2.3 mm below the alveolar margin on the distal side.

The left P4, M1, M2, and M3 are missing. Thus the pattern of tooth loss in the mandible is on the opposite side of the jaw. The right dentition was lost first in the maxilla. These teeth were lost long before death. The corpus has been reduced to a superior-inferior thickness of 10.93 mm at a location parallel to the right M3. The alveoli are completely resorbed. The right P4 is worn in a manner resembling the left P3. The crown has been obliterated and in this case secondary dentine has formed at the opening to the exposed pulp chamber. The right first and second molars are missing antemortem. The alveoli are almost completely resorbed except for a small depression where the M2 had been. The right third molar is present in situ. The occlusal surface is worn to a deep basin and only a thin rim of enamel surrounds the outer perimeter of the trigon cusps. The distolingual cusp remains with only a rounded occlusal surface and a pin prick dentine exposure.

There are mild calculus deposits on the lingual surface of the right canine, the buccal surfaces of the right canine, third and fourth premolars. The calculus deposits are located approximately half way down the length of the root confirming the exposure of at least half the root surfaces in life.

The extreme amount of AMTL in this individual, combined with evidence for attrition, calculus formation, hypercementosis, resorption of the alveolar margins, and periapical abscesses suggests that this individual suffered from severe periodontal disease and lost the majority of the maxillary teeth and the posterior mandibular teeth early in life. This individual may also have been using his teeth for some occupational or behavioral practice, which may have accelerated the level of attrition, caused exposure of the pulp chamber, and subsequent loss of the teeth. Certainly some idiosyncrasy is suggested by the loss of the right maxillary dentition and the left posterior mandibular dentition first.

There was an interproximal wear groove developing on the distal surface of lower right P3, near the CEJ, which also indicates that this individual was placing something in the mouth either occupationally or as a probe, such as a tooth-pick. This behaviour, if not occupational, may have been related to discomfort experienced in this region either from the periapical abscess beneath this tooth or from prior discomfort felt prior to the loss of the right P4.

The obvious enamel defects on the lower left and right canines suggest that this individual suffered from growth disruptions early in life, at approximately 3 years of age. It is possible that this stress was related to nutritional insufficiency, or diarrhoea from unclean water or other sanitation issues around the age of weaning completion. Alternatively defects around 3 years of age may represent stress associated with the inter-birth interval, if sibling competition prevented the child from receiving adequate nutrition or if the child was exposed to unsanitary conditions while being watched by allomothers, such as older siblings. There was no evidence for carious lesions or other problems generally associated with farming subsistence and consumption of sticky, processed foods.

1997-2

The left M1 is damaged post-mortem and the mesiobuccal surface of the crown is missing enamel. However, there is a carious lesion on the distal portion of the occlusal surface, between the distal cusps. The cavity is full of matrix that cannot be removed so it is difficult to judge the extent of the damage. There is pronounced attrition on the distal cusps. The mesiolingual cusp has only a pinprick of dentine exposure, the distobuccal and distolingual cusps have small dentine lakes. There is also a mild amount of calculus deposited on the lingual surface of the crown at the CEJ.

The left M2 is missing enamel due to post-mortem damage on the lingual surface. The lingual cusps are not observable. Both buccal cusps are rounded with wear and dentine is visible just below the thin layer of enamel, but is not yet exposed. There is an incipient carious lesion that was developing on the distal occlusal surface centred between the two cusps. The position of this cavity is identical to that on the adjacent first molar. The M3 is complete and the cusps are rounded by attrition, with pinprick exposures on the lingual side. There is a moderate size calculus deposit on the lingual surface of the crown near the CEJ. The distal surface of the crown also has a small deposit of calculus.

On the four posterior teeth with intact crowns available for this individual there is evidence for two carious lesions and calculus deposits. The caries are both on the occlusal surface but matrix adhering to the surface prevents examination of the extent of damage to the enamel. There are no anterior teeth available for examination and it is thus not possible to determine whether this individual had enamel defects.

1999-1

The maxillary dentition is complete and in situ, except for the right lateral incisor and right canine which are missing post-mortem. The maxillary teeth are encrusted with some adhering matrix and preservative, which was resistant to removal. Many of the surfaces are difficult to observe. Despite a large amount of occlusal wear, there is no evidence of passive eruption. There is mild deposition of calculus and one carious lesion on the occlusal surface of the right third molar.

The right central incisor is worn to dentine exposure on the occlusal surface. The labial surface has a mild amount of calculus. The right third and fourth premolars are both worn to a flat surface that slopes buccal to lingual. There is a small dentine exposure on the buccal cusps and there is a dentine lake on the lingual side of the fourth premolar. The right first molar is extremely worn and the lingual half of the occlusal surface is one large dentine lake. The enamel surrounds the dentine in a thin margin on the lingual, mesial and distal sides. The occlusal surface has been obliterated by wear. The second molar is worn flat and slopes buccal to lingual. There are three cusps and the lingual cusp has exposed dentine. The third molar has a carious lesion in the centre of the occlusal surface of the crown.

The left central incisor is worn to dentine exposure and the lateral incisor is worn halfway down the crown. The enamel of this tooth is chipped on the mesio-buccal surface. There is a mild calculus deposit on the disto-buccal surface. The left canine is also worn half way down the crown and the enamel is chipped in the centre of the occlusal surface. Both the premolars are worn flat on the occlusal surface and the dentine is exposed. The occlusal surface of the first molar is worn to a flat plane sloping from buccal to lingual on the occlusal surface. The dentine is exposed on all four cusps. There is a moderate amount of calculus on the disto-buccal surface. The three-cusped second molar is slightly less worn than the first. The dentine is exposed on the buccal cusps and there is a dentine lake on the lingual cusp. There is a moderate amount of calculus on the buccal surface. The third molar also has three cusps and is still less worn. There is a deep occlusal basin on this tooth but it is covered with matrix and whether it is a hypoplastic defect or a carious lesion cannot be determined.

The mandible has a stout appearance, the body is short and wide. Matrix covers most of the bone surfaces and some of the enamel as well. The central incisors are missing but matrix obscures the alveoli and it is difficult to evaluate whether the loss was post-mortem or antemortem. The alveolar bone is missing on the labial surface though the damage may be post-mortem. There is a small periapical abscess at the alveolus for the RC. The buccal surfaces of the teeth are obscured by adhering matrix, so LEH and mild calculus deposits are not observable.

The RP3 and RP4 were lost post-mortem, the alveolar margins are visible and are still sharp. There is a large periapical abscess that has penetrated the alveoli for both teeth. There is a small carious lesion on the distal half of the occlusal surface of the LP4, there is some matrix adhering to the surface but it appears that the LM1 was also affected at the mesial half of the occlusal surface. The RM2 was definitely lost antemortem as the alveolar bone is completely resorbed and remodeled. The buccal surfaces of the LP4, M1, M2, and M3 are free of matrix and there is no calculus deposition observable.

This individual suffered from three caries, calculus, and two periapical abscesses. There is no evidence for AMTL although not all of the alveolar margins are completely observable. There is also no evidence for enamel defects.

1999-2

Six isolated tooth fragments were recovered from the faunal remains excavated from this unit. The dental remains cannot be firmly associated with the skeletal remains but it is thought that they belong to the same individual. The dental remains of this individual are partially obscured by hard matrix. Thus not all surfaces are visible.

The left maxillary canine is represented by a fragment of the crown. The root and the CEJ are missing; the occlusal surface, mesial and distal marginal ridges are present. The occlusal surface is worn in a mesial to distal direction and the dentine is exposed. There is a wear facet for the left lateral incisor on the mesial surface. There is a mild amount of calculus present on the lingual and labial surfaces of the tooth towards the CEJ. There are three LEH defects present but the CEJ is missing and distance cannot be determined.

The lower left canine is also represented by a crown fragment, the CEJ and root are similarly missing. The crown is damaged post-mortem on the disto-lingual surface and the enamel is missing. The crown is worn on the occlusal surface and the dentine is exposed. There is a mild amount of calculus on the mesial half of the lingual surface of the tooth. There are three LEH defects present but the CEJ is missing and distance cannot be determined.

The lower right fourth premolar is almost complete, only the apical portion of the root is missing. The crown enamel is worn to a flat plane that slopes buccal to lingual. There are pinprick sized dentine exposures at the buccal, mesio- and disto-lingual cusps. There are interproximal wear facets visible on both the mesial and distal surfaces. There is a mild amount of calculus present on the lingual surface near the CEJ. There is also a mild amount present at the mesial and distal margins of the buccal surface. There are LEH defects visible on this tooth as well but they are slight and will not be included in analysis.

The occlusal half of the lower left first molar crown is present. The occlusal surface has four cusps with a "+" fissure pattern. The surface is worn from the lingual to the buccal surface. There are interproximal wear facets on the mesial and distal surfaces. There is a moderate amount of calculus on the lingual surface and a mild amount on the mesio-buccal surface.

The lower right first molar is similarly broken and only the occlusal half of the crown remains for this tooth. The crown again has four cusps and a "+" fissure pattern. The tooth is worn in a lingual to buccal direction. There are interproximal wear facets on the mesial and distal surfaces. There is a moderate amount of calculus on the lingual surface and a small deposit on the distobuccal surface.

The occlusal half of the lower right second molar crown is present also. The crown has four cusps with a "+" fissure pattern. The wear proceeds in a lingual to buccal direction. There is a wear facet on the mesial surface but none on the distal. There is also a moderate amount of calculus on the lingual surface.

Three distinct enamel defects are visible on the maxillary and mandibular canines and thus although precise timing cannot be calculated because the crown is broken and missing the CEJ, it is evident that there were three distinct stress events prior to the age of crown completion at 4 years +/- 12 months. This individual also had a mild to moderate amount of calculus build-up. As the teeth are isolates, AMTL, abscess, and alveolar resorption cannot be evaluated. There is no evidence of caries in the 8 teeth present.

1999-3

The dental remains are well preserved and relatively complete though also fragmentary. This individual also shows evidence of developmental stress in the form of LEH on the upper right (5.03 mm from the CEJ) and left central incisors (5.03 mm from the CEJ), the lower right lateral incisor (2.12 mm from the CEJ), the lower right (2.81 mm) and left canines (faint and not recorded). There are carious lesions on the upper left and lower right fourth premolars, as well as the lower right and left second molars. There is mild to moderate calculus deposition. The teeth are also heavily worn and dentine exposed.

All of the teeth are worn and the dentine exposed. The canine retains mesial and distal marginal ridges though the tooth is worn heavily. There is a small amount of calculus on the mesio-lingual surface and a mild amount on the labial surface at the gingival margin. The premolars are also worn to dentine exposure and the cusps are rounded, not yet flattened. There is one interproximal cavity on the mesial surface of the fourth premolar and a moderated amount of calculus deposit on the buccal surfaces of both the premolars.

The upper left first molar has a prominent hypocone that is slightly worn on the occlusal surface. All of the trigonid cusps are worn to dentine exposure. There is a moderate amount of calculus on the buccal surface and a mild amount on the buccal side of the distal surface. There is an interproximal wear facet on the distal surface also. The left I1 has an interesting occlusal wear pattern – the wear slopes from mesial to distal and dips at the distal end. The dip resembles a groove or a break whose sharp edges were softened with wear over time. It is difficult to say without the left lateral incisor. There is no similar groove on the right central incisor. There is also a mild amount of calculus on the labial surface of the left central incisor. There are two faint LEH defects on both incisors. They were minor disruptions and the grooves are not very deep.

The upper left third molar has a moderately developed hypocone. The cusps are slightly worn and there is no dentine exposure. There is an interproximal wear facet on the mesial but not the distal surface. There is also a mild to moderate calculus deposit covering half of the perimeter of the CEJ from the disto-lingual to the mesio-buccal surface.

The right mandibular central incisor has a mild amount of calculus on the mesio-labial surface. The occlusal surface is worn in a mesial to distal direction and the dentine is exposed. The right lateral incisor is also worn and the dentine exposed. There is a slight LEH defect visible 2.12 mm from the CEJ. The right canine is worn in a plane that slopes from mesial to distal on the occlusal surface and the dentine is slightly exposed. There is a small amount of calculus on the labial surface near the CEJ and an LEH defect is visible just above, at 2.81 mm.

The cusps of the right third and fourth premolars are rounded by occlusal wear and there is a small dentine exposure on the buccal cusps. On the fourth premolar, there is a carious lesion on the mesiolingual side of the occlusal surface and a small calculus deposit on the disto-lingual surface. The right first molar has four cusps but the fissure pattern is not observable due to a broad, shallow occlusal basin located directly in the centre of the crown. All four cusps are worn to dentine exposure and the wear proceeds from lingual to buccal. There is a large wear facet for the third premolar on the mesial surface. There are marginal remains of a calculus deposit crossing the entire length of the lingual surface; the deposit itself has been broken off.

The right second molar was also four-cusped but the mesio-lingual cusp has been completely obliterated by an occlusal caries. The lesion has destroyed all of the enamel on the lingual side of the cusp and its depth reaches the pulp chamber. The three remaining cusps are rounded by occlusal wear but no dentine exposure has occurred. There is mild to moderate amounts of calculus on both the buccal and distal surfaces. The lingual surface shows evidence of some calculus deposition but the deposit has been removed.

The right third molar crown is unworn on the occlusal surface. There is a small amount of the alveolus present which can be fit together with the rest of the right mandible, in so doing it is obvious that the third molar was fully erupted but the occlusal surface of the crown did not reach the occlusal plane. The tooth was also offset distally leaving a large interproximal space. There are no wear facets on the mesial surface of this tooth nor on the distal surface of the second molar.

Table 9: Odontometrics

Individual	Tooth	Mesiodistal	Buccolingual	Crown Area MD x BL	Crown Index (BL x 100) / MD	Crown Module (MD + BL) / 2
1997-1	ULM1	9.42	9.73	91.66	103.29	9.57
	URM2	8.99	11.06	99.43	123.03	10.03
	LRI1	4.18	5.82	24.33	139.23	5.00
	LLI1	4.32	5.86	25.32	135.65	5.09
	LRI2	5.53	6.62	36.61	119.71	6.08
	LLI2	4.82	6.48	31.23	134.44	5.65
	LRC	6.95	8.32	57.82	119.71	7.64
	LLC	5.96	8.41	50.12	141.11	7.19
	LRP3	6.15	8.14	50.06	132.36	7.15
	LLP3	3.83	6.81	26.08	177.81	5.32
	LRP4	4.41	5.68	25.05	128.80	5.05
	LRM3	9.58	9.89	94.75	103.24	9.74
1997-2	LLM1	10.45	Damaged	na	Na	na
	LLM2	10.65	Damaged	na	Na	na
	LLM3	9.84	8.89	87.48		9.37
1999-1	LRC	6.27	6.66			
	LLP3	5.91	7.94			
1999-2	ULC	7.51	8.35	62.71	111.19	7.93
	LLC	7.53	Damaged			
	LRP4	7.20	8.52	61.34	118.33	7.86
	LRM1	11.15	10.04	111.95	90.04	10.60
	LLM1	11.54	10.13	116.90	87.78	10.84
	LLM3	10.79	9.93	107.14	92.03	10.36
1999-3	URI1	8.26	6.58	54.35	79.66	27.18
	ULI1	8.50	6.97	59.25	82.00	29.62
	ULC	7.38	8.00	59.04	108.40	29.52
	ULP3	6.46	8.55	55.23	132.35	27.62
	ULP4	5.83	8.34	48.62	143.05	24.31
	ULM1	9.77	10.11	98.77	103.48	49.39
	ULM2	9.79	11.51	112.68	117.57	56.34
	LRI2	6.03	6.10	36.78	101.16	18.39
	LRC	6.18	6.76	41.78	109.39	20.89
	LLC	6.67	7.21	48.09	108.10	24.05
	LRP3	6.44	7.22	46.50	112.11	23.25
	LLP3	6.46	6.73	43.48	104.18	21.74
	LRP4	6.48	7.05	45.68	108.80	22.84
	LLP4	6.22	7.18	44.66	115.43	22.33
	LRM1	9.73	10.79	104.99	110.89	52.49
	LLM1	10.01	10.58	105.91	105.69	52.95
	LRM2	8.94	9.63	86.09	107.72	43.05
	LLM2	9.65	9.37	90.42	97.10	45.21
	LRM3	8.28	10.14	83.96	122.46	41.98

The left canine is present as an insolated fragment- the crown is complete but three-quarters of the root is missing. The occlusal surface is worn mesial to distal and the dentine is exposed. There is a mild to moderate amount of calculus on the labial surface which partially obscures a faint LEH defect near to the CEJ. There is a small calculus deposit on the mesio-labial surface also. The left third premolar is rounded with occlusal wear and there is a pinprick size dentine exposure on the buccal cusp. The fourth premolar is similarly worn but there is an additional dentine exposure on the mesio-lingual side of the occlusal surface. There is a mild amount of calculus on the disto-lingual surface.

The left first molar has four cusps but a shallow, broad hypoplastic basin in the centre of the crown disrupts the fissure pattern. Dentine is exposed on all four cusps and the wear plane slopes from lingual to buccal. There is a mild amount of calculus on both buccal and lingual surfaces. The second molar also has a broad occlusal basin and a small carious lesion has begun to affect the mesio-lingual cusp. The cusps are comparatively unworn. There is a moderate amount of calculus deposited on the lingual and distal surfaces.

Pathological profiles and analysis is provided in a previous paper (Robbins *et al.* 2006). Odontometrics are provided below including mesiodistal (MD) and buccolingual (BL) dimensions and several indices for comparison (Table 9). The mean crown area (a product of both the length and breadth of the crown) for each tooth class can be summed for all individuals and compared between sites to evaluate dental robusticity and dietary adaptations. For example, Mesolithic groups from the Ganga Plains have some of the largest average summed crown areas in South Asia (~1300 mm^2 for Mahadaha) while agricultural communities in the Indus Valley or the Deccan Chalcolithic have much smaller areas. This may represent tooth size reduction with the shift to agriculture and a softer, more processed diet. For this sample the total summed crown area is not possible to calculate because there are too many teeth missing.

Discussion

No regular burial ground was uncovered at the site of Balathal after five seven seasons of excavation. Only these five adult individuals (Table 10) were recovered from this large agrarian village. Two of these individuals were recovered from the B Phase of the Chalcolithic (c. 4400-3800 BP) deposit and three additional individuals were recovered from the Early Historic layers (c. 2200-1800 BP). In all the remains of four adults are fairly well preserved and relatively complete. We can learn something about the characteristics of these 2 males and females from the Chalcolithic and Early Historic periods, respectively. This report provides the inventory, description, age and sex estimates, and measurements as a basis for future research. A previously published report provided an interpretation of the osteobiographies of these individuals and the pathological profile for this site (Robbins *et al.* 2006).

Interpretations of skeletal and dental pathology as it relates to subsistence and activity are provided in a previous paper (Robbins *et al.* 2006). The high frequency of caries meets expectations for populations relying on agriculture and a few staple foods that are high in carbohydrates, heavily processed, and sticky (Lukacs 1989). The high caries rate is also associated with a high rate of alveolar abscess and ante-mortem tooth loss. Calculus and heavy attrition were not an issue for this population. In addition, the dental pathological profile showed evidence for developmental stress around 3 to 4 years of age. These growth disruptions could be related to infant feeding practices, socio-sanitation issues, and/or inter-birth interval. This developmental stress did not result in fluctuating odontometric asymmetry but may have contributed to short adult stature, which is within the range expected for Chalcolithic India.

Burial practices and mortuary treatment in general can be examined for implications about social conditions and cultural traditions. No regular burial ground was uncovered at the site of Balathal during five seasons of excavation. Only these five adult individuals and two subadults (Mushrif, n.d.) were recovered from this large agrarian

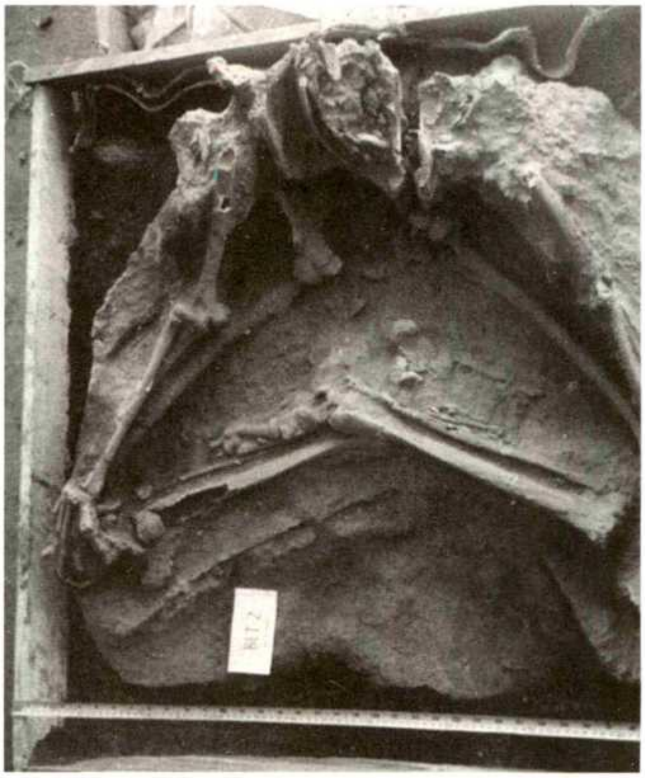

Fig. 5 BTL 1999-2 individual was discovered in a burial posture reminiscent of a contemporary *Samhadi* style burial treatment. There was no evidence of pathology in the exposed surfaces (Robbins *et al.* 2006)

Table 10: Summary of burials

Individual	Cultural Association	Burial Posture	Sex	Age Estimate	Mean Age	Skeletal Pathology
1997-1	Early Historic	flexed on L side	M	30-50	40	OA, VOP, cervical spondylosis, and lunate fracture
1997-2	Early Historic	co-mingled	-	17-32	25	None
1999-1	Chalcolithic	flexed, on R side	F?	35-55	45	Schmorl's node C2/C3
1999-2	Early historic	seated with hands on knees	M?	20-40	30	none observed
1999-3	Chalcolithic		F	25-35	30	thoracic compression fracture, spondylitis, pelvic fracture, sub-luxation of the acetabulum, necrosis of the femoral head

village. Two of these individuals were recovered from the B Phase of the Chalcolithic (4400-3800 BP) deposit and three additional individuals were recovered from the Early Historic layers (2300-1800 BP). The individuals who were buried at Balathal may represent a form of mortuary bias or possibly cultural categories of individuals (or causes of death) that required special mortuary treatment. This seems to be a particularly appropriate interpretation for individual 1999-2, who was buried in a careful and deliberate style, positioned in a manner quite similar to the *samadhi* posture associated with males in the *grihasti* (householder) or later *sannyasi* (ascetic) life stages.

Individual 1997-1 was an older adult male that had suffered the stresses of prolonged and rigorous labour, as evidenced by his advanced state of degenerative joint disease in many of the diarthrodial joints as well as the spine. This individual also suffered from several severe stresses during the developmental period. The timing of these childhood stresses indicates that stress levels were sufficient to impact growth and development around three years of age. This individual also suffered a lunate fracture probably as a result of a direct blow to the ulnar aspect of the wrist or forceful hyperextension, such as in a fall on outstretched hand. This man was not carefully and deliberately buried but was found in a haphazard posture suggestive of careless dumping of the carcass within the cow dung deposits found in the fortified area.

Two individuals from the Chalcolithic context were females in middle to older adult age categories. Individual 1999-1 was in excellent skeletal health and may not have performed a large amount of strenuous labour, at least in terms of evidence from degenerative joint disease and musculoskeletal markers. This individual was also the only skeleton in this sequence that showed evidence of careful placement, with the body arranged in a flexed posture, and the presence of a single pot near her head. In contrast, Individual 1999-3 was a middle aged female that had suffered from serious injury and subsequent degenerative joint diseases that would have left her partially disabled. This individual also suffered from developmental stress severe enough to disrupt enamel formation around the third year of life.

This collection is remarkable in the pathological conditions present, evidence of differential burial practices, and potentially for evidence of social hierarchies at least in mortuary treatment. The two individuals with no evidence, or limited evidence for work related or traumatic pathology, demonstrated deliberate burial postures and grave goods. The two individuals that had evidence of traumatic injury and work related stress were buried in unceremonious postures and without burial goods. While sample size is small, these relationships do not conflict with expectations one might develop based on an understanding of social stratification in Vedic practice, practices that were established in parts of India prior to the third millennium B.C.

Acknowledgements

The authors thank Dr. S.R. Walimbe for taking measurements.

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B. Patra, *Man and Environment* XXXII(2): 27-36 [2007].
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Early Historic Urban Centres of Western Orissa: An Archaeological Study

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Abstract

The study of urban centres and urbanization in ancient India is a significant aspect of the historical research. As elsewhere in India, urban centres flourished in Orissa during the ancient period. Tamralipti, *Che-li-ta-lo*, Palur, Pithunda thrived exclusively as maritime settlements whereas Sisupalgarh, Jaugada, Dhauli, Jajpur, Ekamrakshetra (Bhubaneswar) developed with multifaceted activities. Western Orissa has not received much attention though it contributed to the process of urbanization during the ancient period. This present paper endeavours to trace the growth, pattern and archaeological significance of Early Historic urban centres of western Orissa. Due emphasis has been laid on the social, economic, administrative and cultural aspects of the sites in the light of explored and excavated archaeological materials. Asurgarh, Kharligarh, Buddhigarh, Sonepur, Maraguda, Jumlagarh, Junagarh etc. are some of the major Early Historic urban centres of western Orissa that have been discussed in this paper.

Introduction

Urbanization in general represents a process of growth and development. The study of urban history is essential for an understanding of a given society in its social and economic perspective. Urbanization, in fact, is a complex socio-economic process intimately connected with the scientific-technological revolution which exercises a growing influence on all aspects of society affecting the nature of economic development as well as demographic, ethnic, and many other social processes. It is a process in which rural areas get transformed into urban centres and the number of towns increases with a disproportionate decrease in rural areas. Urban centres are the points of convergence and open to all. Emphasizing the role of the town in the evolution of society and civilization, Mumford (1938: 3) remarks, "The city, as one finds it in history, is the point of maximum concentration for the power and culture of a community. It is the place where the rays of the many separate beams of light fall into focus, with gains in both social effectiveness and significance. The city is the form and symbol of an integrated social relationship; it is the seat of the temple, the market, the hall of justice, the academy of learning. Here in the city, the goods of civilization are multiplied and manifolded; here is where the human experience is transformed into visible signs, symbols, patterns of conduct, system of order. Here is where the issues of civilization are focused; here too the ritual passes on occasion into active drama of a full, differentiated and self-conscious society".

From the 6th century B.C (beginning of the second phase of urbanization), urban centres flourished at important strategic points as citadels of government, centres of learning and culture, places of pilgrimage and as emporiums of trade and trans-oceanic commerce. Pataliputra served as the capital of the imperialistic rulers while Ujjain and Taxila became the centres of learning and culture and places like Tamralipti, Chandraketugarh, Vaisali, Vidisa, Broach, Arikamedu, etc. flourished as trade settlements.

The dated evidence for the emergence of urban settlements in the Orissan context can be traced back to the period of Ashokan invasion of Kalinga in the 3rd century B.C. which is tangibly attested by the excavations at Dhauli and Jaugada, the two provincial headquarters of Kalinga province of Ashoka's empire. The existence of urban centres prior to this time cannot be entirely ruled out. The excavations at Sisupalagarh (Lal 1949: 62-105; Mohanty and Smith 2006) provides further evidence of a well-planned early historical city of Orissa which remained under occupation between *c.* 3rd/4th century B.C. and *c.* 3rd century A.D. Besides this, some others like Tamralipti, Palur, *Che-li-ta-lo*/ Manikpatna, Kalingapatnam, Pithunda, Lalitgiri, Udayagiri, Langudi, etc. were flourishing either as religious centres or as political-cum-trading settlements. Urban historical studies of India in general and of ancient Orissa, in particular, are still in their formative stage. A few scholars (Ghosh 1973; Thakur 1981; Sharma 1987; Allchin 1995; Champakalakshmi 2006; Chakrabarti 2006) have shown interest in the study of the complex process of

Received : 7-2-2007
Revised : 18-5-2007
Accepted : 13-7-2007

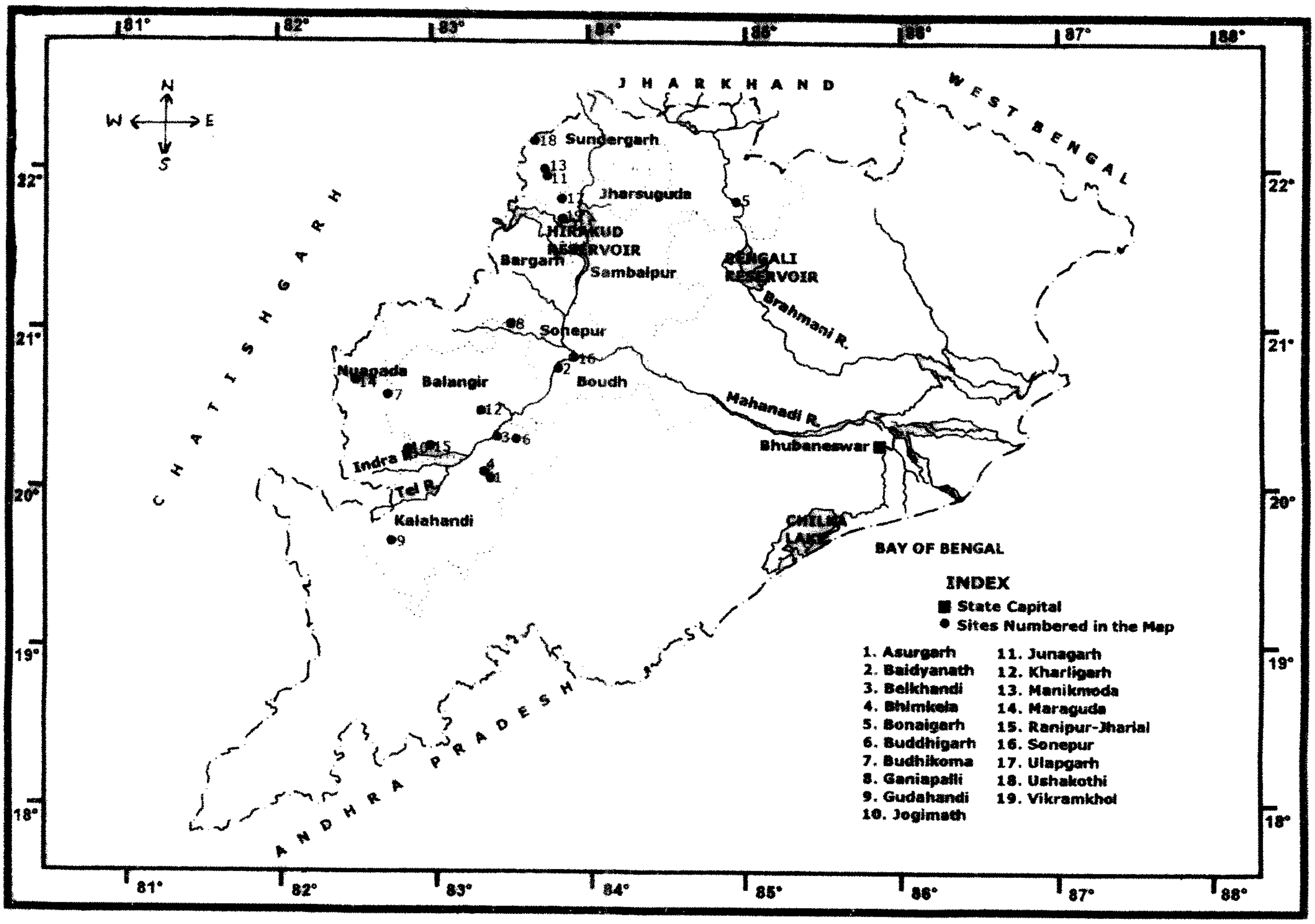

Fig. 1 Map showing ancient sites/Urban settlements in western Orissa

urbanization in ancient India. So far the urban ancient Orissa, especially in the western part Orissa, remain relatively poorly studied. In the present article, however, an attempt has been made to trace the growth and significance of urban centres of western Orissa during the Early Historic period (Table 1, Fig. 1).

Western Orissa roughly comprises undivided Sambalpur, Bolangir, Kalahandi and Sundargarh (new Sambalpur, Bargarh, Deogarh, Jharsuguda, Sonepur, Bolangir, Kalahandi, Nuapada and Sundargarh) districts of Orissa. In ancient times, particularly during the Early Historic period many urban settlements were developed in this part of the state. Evidence of the Stone Age, Chalcolithic and Megalithic cultures is also available here. Supplementing literary sources, systematic archaeological exploration and excavations during the last century have also revealed the growth and decline of urban cultures and urbanization in Western Orissa. Perennial rivers such as the Mahanadi, Tel, Indravati, Jonk, Ang, Ib, Brahmani; and the valleys and plateaus created by them, provided a conducive atmosphere for the growth of urban centres. It is significant to mention here that Ball (1876: 122-23) in 1876 picked up four stone tools (Palaeoliths), some of the first to be found in Orissa from Kudabaga (Kudderbuga) near Bursapali in the Sambalpur district. The pictographic writing on the wall of a cave at Vikramkhol (Fig. 2) near Belpahar (Jharsuguda district) about 25.75 km to the west of Jharsuguda railway station is an important relic of the region. According to Jayaswal (1933: 58-60) the Vikramkhol inscription supplies a link between the passages of letters from the Mohenjodaro script to Brahmi. The pre-historic rock paintings found at Gudahandi (Fig. 3), (Kalahandi district), Jogimath (Fig. 4) (near Khariar in the Nuapada district), Manikmoda and Ushakothi (Sundargarh district) are also worth mentioning. However, the most conspicuous and renowned feature of western Orissa, was the presence of gem stones. The distribution and occurrence of precious and semi-precious gem-stones in western Orissa is mentioned in the classical texts. The diamonds of Hirakud (diamond island) (21° 32' N; 83° 56' E) region of Sambalpur were the most precious item of export and were highly demanded in western countries (Senapati 1971: 1). It is stated that diamonds were sent from Sambalaka (Sambalpur) to other parts of India (Majumdar 1984:77). The Geographer Ptolemy (Majumdar 1981: 367 and 372), in the 2nd century A.D. refers to the town of Sambalpur as Sambalaka and to the great river Mahanadi as Manada from which river bed diamonds were

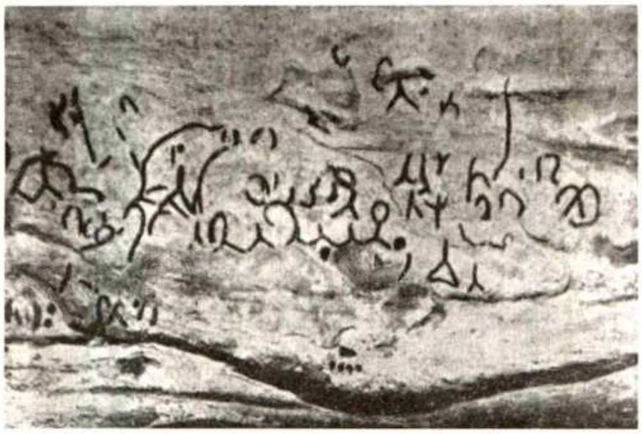

Fig. 2 Pictographic writing on the wall of a cave at Vikramkhol

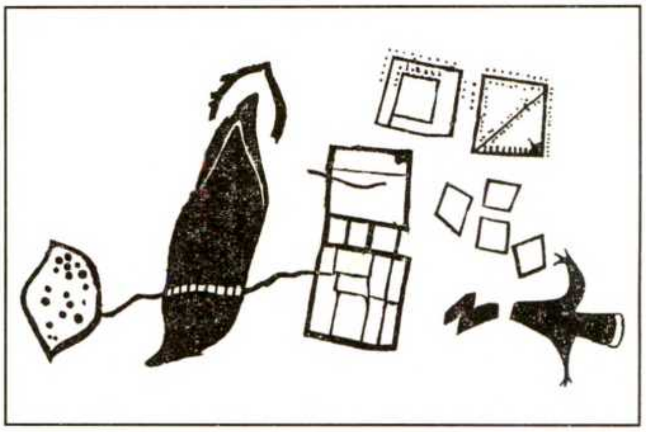

Fig. 3 Rock paintings at Gudahandi

extracted at Hirakud. Besides diamond, the other precious gemstone deposits worthy of mention are cat's eye, sapphire, ruby, garnet, crystal, topaz, moonstone, tourmaline, aquamarine, beryl and alexandrite. It is also very rich in archaeological remains in the form of religious shrines, loose sculptures, military strongholds, numismatic finds and epigraphic records.

Asurgarh (20° 4' 40" N; 83° 21' 16" E)

Asurgarh, literally meaning the fort of the demons, is an important ancient fort-town of western Orissa (Fig. 5). It is located near Rupra Road railway station about 2 km from the Narla village in the district of Kalahandi. It is about 20 km from Bhawanipatna, the district headquarters of Kalahandi. Archaeological exploration and excavations conducted here have thrown significant light on the history and culture of western Orissa during the Early Historic period (Behra 1982; Mohanty *et al.* 1997-98).

The fort, square on plan, each side measuring about 1 km in length, had four wide gates in the four cardinal directions. At each gate one guardian deity was installed: Ganga Devi (east), Kalapata Devi (west), Vaishnavi Devi (north) and Buddharaj (south). Goddess Dokry, enshrined inside was the presiding deity of the fort. The ramparts as found at present are about 4 m in width and 15 to 50 m in height, and are made of rubbles and mud with brick facing. The river Sandul flows by the western side of the fort providing a natural boundary and meets the river Tel at some distance. The fort is circumscribed by a moat on three sides, which is fed by a vast ancient tank covering an area of 80.94 ha (on eastern side of the fort). It is presumed that the palace was constructed at the centre of the fort (Mohanty 2000: 655). It was during the 2nd half of the 19th century that Raja Udit Pratap Dev renovated the ancient tank for agricultural purposes and at present, it is known as *Udit Sagar* after the name of its renovator (Sahu 1976a: 344; Singh 2004: 50). The fort in totality resembles that of Sisupalagarh. The remains of the fort prominently point to building activities and engineering skills of the people of that time.

The Department of History, Sambalpur University and the Department of Culture, Goverment of Orissa, and under the initiative of N.K. Sahu (Behera 1982: 7) undertook a limited excavation at Asurgarh in 1973. Trenches were dug in the eastern and western parts of the fort. The excavation yielded many antiquities such as a paved house floor, iron implements of war and peace, beads made of precious and semi-precious stones like agate, chalcedony, carnelian, crystal and coral, punch-marked silver and copper coins, Black-and-Red ware, terracotta figurines (Fig. 6), terracotta and silver ornaments, glass bangles, amulets, etc. One of the excavated Kushana coins contains the figure of Kanishka (*c.* 1st century A.D.). A trial trench in the middle of the area brought to light a circular brick structure of 12.19 m in diameter, which N.K. Sahu assigns to the presiding goddess of the fort (Sahu 1976b: 6; Das 1983: 88).

A hoard of 539 silver coins collected by Deo (1966: 28), the Maharaja of Kalahandi furnishes considerable cultural information of the area. This hoard has been chronologically divided into three groups. The first group consisting of 69 coins is assigned to the pre-Mauryan period, the second group (272 coins) to the Mauryan rule, and the last group (198 coins) to the post-Mauryan period. The unfinished coins found from the site indicate that there was probably a mint for punch-marked coins at Asurgarh. The similarity of some of the punch-marked coins of Asurgarh with those of Bijnor and Palia near Kausambi, and the similarity in texture and fabric of some pottery types have with those found at Ahichhatra, indicate that there was trade between Asurgarh and prosperous towns such as Kausambi and Ahichhatra (Mohapatra 1986: 236). The findings of red glazed Kushana pottery along with highly polished black wares further indicate to cultural and commercial contacts of the region with the Kushana empire during the 1st century.

Table 1: Ancient sites/Urban settlements in western Orissa

Name of the Site	Latitude	Longitude	District	Period	Features/ Category	Significance/Relevant Information
Asurgarh	20^0 4’ 40” N	83^0 21’ 46” E	Kalahandi	*c* 3rd century B.C. to *c* 6th century A.D.	Urban Centre, Ancient Fort, beads manufacturing industry.	Asurgarh fort is protected by ASI
Baidyanath	20^0 49’ 36” N	83^0 48’ 46” E	Sonepur	*c* 7-8th century A.D.	Famous for Ancient temples and sculptures, Centre of Culture.	Kosalesvara temple at Baidynath is protected by Orissa State Archaeology (OSA)
Belkhandi	20^0 21’ 38” N	83^0 25’ 54” E	Kalahandi	Somavamsi Period	Archaeological remains, Saptamatruka temple, Saptamatruka images.	---
Bhimkela	20^0 4’ 54” N	83^0 20’ 34” E	Kalahandi	Early historic (*c* 3rd century B.C.)	TrA.D.ing centre, yielded some Indo-pacific glass beads and etched beads a piece of brilliantly polished agate bowl (*c* 3rd century B.C.)	---
Bonaigarh	21^0 48’ 11” N	84^0 57’ 7” E	Sundargarh	Pre-historic (Neolithic up to *c* 14th century A.D.)	Contain a series of temples, origin traced back to the Bhaumakaras.	---
Buddhigarh	20^0 19’ 32” N	83^0 32’ 10” E	Kalahandi	Neolithic (Early historic to late Medieval)	Urban Centre, Ancient fort, yielded some Indo-pacific glass beads and etched beads	---
Budhikoma	20^0 34’ 23” N	82^0 42’ 18” E	Nuapada	*c* 9th century A.D.	Religious-cum-cultural centre, temples and sculptures.	Patalesvara temple is protected by OSA.
Ganiapalli	21^0 4’ 47” N	83^0 29’ 34” E	Bargarh	Early historic period	Buddhist establishment.	—
Gudahandi	19^0 40’ 23” N	82^0 43’ 58” E	Kalahandi	Pre-historic (upper Palaeolithic Age.)	Rock shelters with pre-historic painting.	—
Jogimath	20^0 17’ 37” N	82^0 48’ 18” E	Nuapada	Pre-historic (Neolithic) pre-historic painting.	Rock shelters with Rock Paintings protected by OSA.	—

Name of the Site	Latitude				Longitude				District	Period	Features/ Category	Significance/Relevant Information
Junagarh	21^0	58'	12"	N	83^0	44'	34"	E	Sundergarh	Local Keshari rule	Hill fortress, excavated relics indicate to religious affiliation of the inhabitants.	—
Kharligarh	20^0	28'	36"	N	83^0	33'	14"	E	Bolangir	*c* 2nd century B.C. to *c* 4th century A.D.	Urban centre.	—
Manikmoda	21^0	58'	43"	N	83^0	44'	10"	E	Sundargarh	Pre-historic	Rock shelters with pre-historic painting; the cave contains as many as 150 paintings.	—
Maraguda	20^0	42'	14"	N	82^0	28'	26"	E	NuapA.D.a	*c* 5th century A.D. to 16th century A.D.	Urban centre, capital city, cultural centre, Buddhist heritage.	—
Ranipur-Jharial	20^0	17'	52"	N	82^0	85'	1"	E	Bolangir	*c* 7th century A.D. to *c* 10th century A.D.	Numerous temples, famous Yogini temple, Buddhist heritage, centre of tantric worship.	Somesvara and Indralath temple OSA protected; Yogini temple ASI protected.
Sonepur	20^0	1'	50"	N	83^0	1'	54"	E	Sonepur	Early historic to Medieval period	Urban centre, capital city, temple city of Western Orissa, Buddhist heritage, during the Somavamsi rule it was a flourishing centre of religion.	—
Ulapgarh	21^0	51'	56"	N	83^0	49'	26"	E	Jharsuguda	Pre-historic	Rock shelters with pre-historic painting.	—
Ushakothi	22^0	12'	7"	N	83^0	40'	23"	E	Sundargarh	Pre-historic	Rock shelters with pre-historic painting.	—
Vikramkhol	21^0	43'	1"	N	83^0	50'	52"	E	Jharsuguda	Pre-historic (*c* 1500 B.C.)	Rock shelters with pre-historic painting, depiction of a pictographic inscription; the script of Vikramkhol is earlier than Brahmi .	Rock shelter Painting ASI Protected.

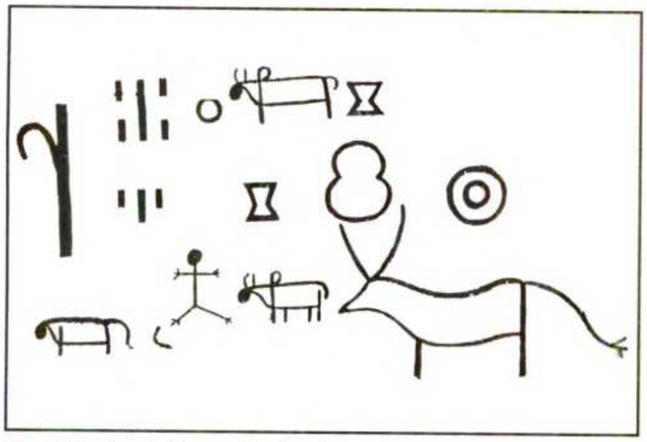

Fig. 4 Rock paintings at Jogimath

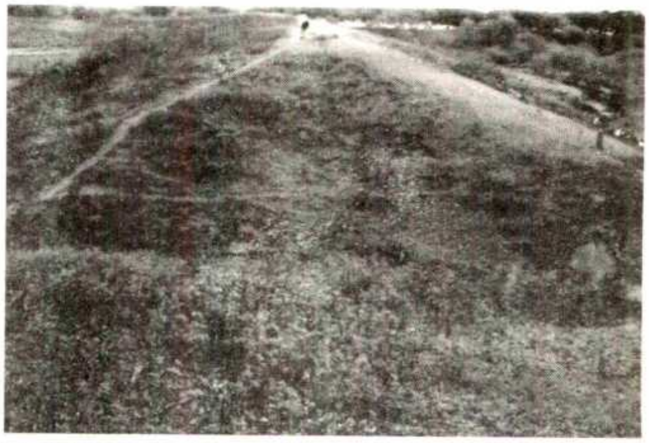

Fig. 5 Aerial view of Asurgarh fort

Asurgarh, without doubt, was an important ancient urban centre of western Orissa. Owing to its strategic location on the high road joining south Kosala and Mahakantara with Kalinga, it developed both as a political and commercial centre. On the basis of numismatic remains and excavated materials Das (1983: 87) attributes the period of occupation of the fort from the *c.* 3rd century B.C. to the 5th century A.D. The discovery of the Terasingha copper plate grant of Maharaja Tustikara (5th century A.D.) near Asurgarh also points to an antiquity of the 5th century A.D. The excavation, however, reveals that the fort area was deserted after the 5th-6th century A.D., and it is presumed that Tustikara, a great devotee of goddess Stambhesvari was the last ruler of the Asurgarh region. It is significant to note that Hiuen Tsang, the Chinese pilgrim who travelled through this area in the 1st half of the 7th century A.D. does not mention either Mahakantara or Asurgarh. Thus it is presumed that by that time, the fort might have lost its importance.

Besides Asurgarh of the Kalahandi district, there is another Asurgarh near Manamunda in the district of Sonepur believed to be the fort of legendary Gosingha Daitya (demon Gosingha). The fort does not exist at present. The high mounds and brick structures at the site, however, led one to assume that it was an important urban site in ancient times. Objects of archaeological importance buried under the mound are exposed by rain and inundation caused by high flood. The surface findings at this site include broken pot sherds with and without decoration, painting and graffiti marks, ornaments made of copper, bronze and semi-precious gem stones, terracotta ornaments, figurines and toys, copper nails, fishing hooks, polished stone axes and flint knives (Chhotroy 2004: 90).

Kharligarh (20° 28' 36" N; 83° 33' 14" E)

The Early Historic fort of Kharligarh is located at a distance of 8.05 km from Tusra in the Tentulikhunti block of the Bolangir district, at the confluence of Tel and Rahul rivers. The location of the fort is very strategic and it was situated on elevated land (about 60.71 ha) in a densely forested environment. The fort is in ruins and lies in loose lateritic soil in an extensive area stretching from the Tel to the Rahul river.

The Kharligarh fort is almost square in plan circumscribed in the north, east and south by rivers acting as natural defence and in the west by an excavated moat connecting both rivers. The rampart consists of burnt bricks (existing to an average height of 4.57 m from the ground level). There is only one gateway on the western side of the fort. At a conspicuous place where the western wall touches the bank of the river Rahul, there are huge mounds of stone and large-sized bricks, which indicate that some large construction existed in the past. It is believed that this marked the residence of the chief (Mohapatra 1986: 222). Mohanty (2000: 656) however, is of the opinion that, "...here the embankment was constructed to divert the water of the river Rahul to the moat as well as the residential area of the fort". Beyond the fort, the adjoining area also shows traces of structure of smaller dimension built of stone and burnt bricks which indicates that there was human habitation on an extensive scale in the past. Inside the fort area several mounds are present covered with shrubs and trees. The central part of the fort contains a shrine on a ruined structure, probably the presiding deity of the fort. The northern rampart is greatly denuded by the Tel river exposing the basement of river-worn stone gravels topped by brick wall of about 5 m wide. The structure shows gradual tapering. The major part of the fort, however, lies intact. The archaeological remains recovered from the site included a large variety of pottery, iron objects, beads of various stones, axes, querns choppers, microlithic artefacts, metal bangles, Kushana copper coins; etc. On the basis of findings, particularly the Kushan coins and the structural remains it is assumed that the fort-town was probably occupied from the *c.* 2nd century B.C. to *c.* 4th century A.D. (Das 1983: 89).

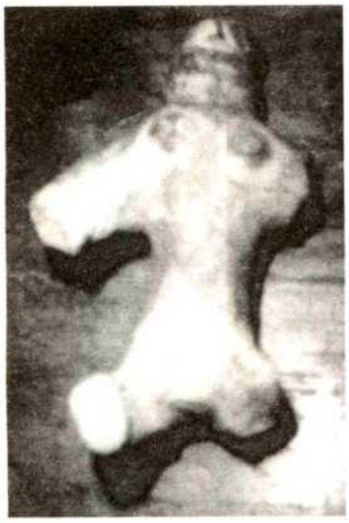

Fig. 6 Terracotta female figurine from Asurgarh

Buddhigarh (20° 19' 32" N: 83° 32' 10" E)

The historic site of Buddhigarh lies 500 m to the east of Madanpur U.P. School in Madanpur village of the Kalahandi district. It is situated on the banks of the Puruna *nala* and the Rahul river which ultimately joins the Tel river. The site is in ruins. The mound is about 3 m in height and covers an area of 1000 x 500 m in north-south direction. Most part of the mound has remained intact, except the middle portion where a path has been made by the villagers to go to the Rahul river. Another portion of the mound adjacent to the village shrine is now under cultivation. The artefactual evidence from the site indicates that the site was occupied from the Early Historic to the Late Medieval period (Mohanty *et al.* 1998-99; Mohanty 2000: 656). A wide spectrum of ceramics, beads, coins, bricks, terracotta objects, iron implements, idols of Durga and Ganesh, and a large quantity of faunal remains and human skeletons were recovered. The bricks from this site measure 45 x 30 x 8 cm. Buddhigarh is also significant for its ceramic industry which consisted of dishes, bowls, miniature bowls, vessels, basins, dish-on-stands, lids, etc.

Sonepur (20° 1' 50" N; 83° 1' 54" E)

Sonepur or Suvarnapur is described in literature (Sahu and Chopdar 2000: 172) (*Kosalananda Kavya*) as 'the second Varanasi', for its past glory, and is another important ancient urban centre of western Orissa. It is situated on the confluence of the rivers Mahanadi and Tel. It is, at present, the headquarters of the district of the same name. Tradition proclaims its link with the origin of Lord Jagannath, and the current assumptions about the location of Ravana's Lanka in Sonepur region has added a new dimension to the historical significance of the place, although both the views are subject to serious scrutiny. The Somavamsi rulers made this town their capital. The coronation of Yayati II (*c.* 1023–1040 A.D.) seems to have taken place at Sonepur where he was "sanctified by the pure water of the confluence of the Mahanadi and Tel" (Panda 1999: 169). Sonepur also served as the capital of the rulers of Bhanja, the Telegu-Choda and the Ganga dynasties. It is recorded that there was a Buddhist vihara at Sonepur, but there is no trace of this at present. However, it is presumed that Buddhist images found in the vicinity of temples in the region originated here. Two unique images related to Tantric Buddhism – one of the goddess Tara and the other of the goddess Marichi have also been discovered at Sonepur (Panda 2000: 25). It is believed that here Lakshmikara propounded the Sahajayana form of Tantric Buddhism, sometime in the eighth century A.D. (Sahu 1958: 142 and 168). At present there are as many as 54 temples of various sizes located here. Kosalesvar temple at Baidyanath, the famous shrine of western Orissa, situated on the bank of river Tel is only about 9 km from Sonepur town. The discovery of a hoard of punch-marked silver coins from Sonepur, some of which are even datable to the pre-Mauryan period, point to flourishing trade and to the economic prosperity of the area. Sahu (1964: 233) thought that the Sonepur-Titilagarh region appears to have been connected with towns like Dantapura and Pithunda in the coastal region of Kalinga on the one hand, and Kausambi and Kasi in ancient Kosala on the other hand.

Maraguda Valley

Urbanization and urban culture was an important feature of the historic Maraguda Valley (Fig. 7). Maraguda (20° 42' 14" N; 82° 28' 26" E) is situated in the Nuapada district of western Orissa. The Maraguda valley is flanked by two hills with the river Jonk flowing in the middle. The river Jonk, in fact, forms the gateway of this prosperous valley. It is believed that Maraguda was the legendary capital 'Kushavati' founded by Kusha, son of Lord Rama of the Ramayana, the historicity of which is yet to be determined. It was, however, the capital of the Sarabhapuriya dynasty who ruled over this region during the 6th and 7th century A.D. The discovery in 1980 of five gold coins of Sri Mahendraditya, one gold coin of Sri Kramaditya and two gold coins of Sri Prasannamatra, from this region substantiates the identification of Sarabhapura (the capital of the Sarabhapuriya kings) with the Maraguda Valley (Singh Deo 1989: 129).

Scholars like Deo (1968: 1-7), the former Maharaja of the feudatory state of Kalahandi, P.K. Ray, the then superintendent of the State Archaeology Department, Orissa, historian N.K. Sahu, C.B. Patel and J.P. Singh Deo have explored and conducted extensive fieldwork in the area and have made valuable contributions. J.P. Singh Deo (1987: 7-8) analysing the discovery of a *yoni*, chiseled on a piece of stone measuring 23 cm, from the Maraguda Valley, opined that there was a Chalcolithic site there in this valley. The '*Yoni*' discovered in 1982 is in the private possession of the author. However, merely on the basis of

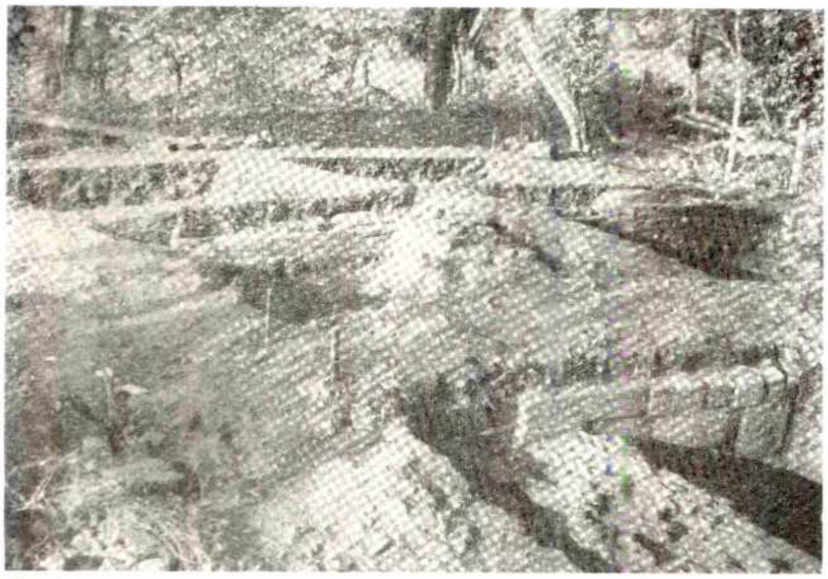

Fig. 7 General view of the site of Maraguda

this discovery it is difficult to trace the antiquity of Maraguda to the Chalcolithic period.

The Maraguda Valley is full of ancient and early medieval antiquities. The ruins of a planned township have been brought to light here. The Orissa State Archaeology Department carried out an excavation in the Maraguda valley (Fig. 8). The excavation has revealed massive structures such as the Mahal mound, Rani Mahal (queen's palace) mound, Trishul mound, Saktipitha, Linga emblems of Lord Shiva and remains of a sprawling city. The most remarkable object excavated from the Trishul mound is a brick temple consisting of *garbhagriha* (sanctum sanctorum) with a *Saktipitha* in worship. The *garbhagriha* measures 3.66 x 3.66 m while the *Saktipitha* measures 0.76 x 0.76 m in height. The porch of this temple is rectangular in plan (1.52 x 2.29 m) and contain eight small female figures. Other antiquities recovered from this area consist of coins, seals, icons, architectural fragments and many other objects of historical importance. Excavations in the Mahal mound area unearthed a double-storied building containing as many as 12 rooms of different dimensions. Excavations in the Rani Mahal mound (the largest mound) have brought to light a huge hall measuring 15.24 x 12.19 m with high wall up to 6.71 m in height, probably used for administrative and political purposes. On the basis of the archaeological findings and excavated antiquities Panda (2000: 25) assigns the date of the Maraguda Valley occupation to a period from *c.* 5th- 6th century A.D. up to as late as the 16th century A.D.

Besides the aforementioned urban centres, evidence of others has also been found from several places in western Orissa such as Dumerbahal, Bhimkela, Gudahandi, Ichhapur, Belkhandi (Kalahandi district), Buddhikoma, Jogimath, Jumlagarh, Manikgarh (Nuapda District), Ganiapalli (Bargarh district), Baidyanath (Sonepur district), Ranipur-Jharial (Bolangir district), Ulapgarh, Vikramkhol (Jharsuguda district), Bonaigarh, Junagarh fort, Manikmoda, Lekhamoda, Ushakothi (Sundargarh district), etc. Manikmoda, Lekhamoda, Ulapgarh, Ushakothi, Gudahandi, Jogimath are famous for rock-cut paintings while Vikramkhol along with paintings is significant for pictographic inscriptions of very remote antiquity. The mound at Dumerbahal, which lies 1 km to the north of the village Dumerbahal on the right bank of the Ret river on the foothill of Gupti Dongar, was an Early Historic urban centre. The site at present, is about 100 m away from the river bed. The total area of the mound is 250 x 125 m and has a deposit of about 10 m. The entire mound is under cultivation. The site has revealed a wide range of Iron Age-Early Historic ceramics which comprise dishes, bowls, vessels, basins, jars and dishes-on-stand (Mohanty 2000: 657). The site of Ichhapur has yielded along with others a number of iron implements from the surface. The finding of Buddhist images of a very early age from Ganiapalli of Bargarh district indicates the existence of a very large ancient Buddhist site.

The hill fortress of Junagarh (Sundargarh district) is situated 4.83 km to the north-west of Hemgiri on the top of a hill, and is surrounded by lofty peaks which served as ramparts making it a natural hill fortress. The extensive ruins of the area revealed that it was a large fort. It is believed that the fort belonged to the local Keshari kings who ruled the area several centuries ago. The Manikmoda cave containing rock-paintings of the pre-historic period is located in the neighbourhood. The relics of Ganesh, female figures and Sivalinga with Saktipitha found in the vicinity of the fortress indicate the religious affiliation of the inhabitants. Ranipur-Jharial (Ranipur and Jharial are two adjacent villages) located in the Sindhikela police station

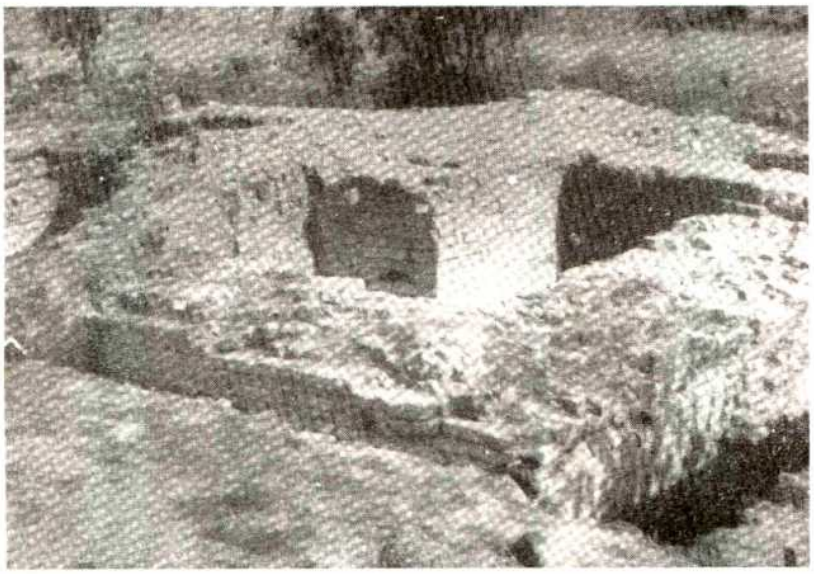

Fig. 8 Excavated structures at Maraguda

of Bolangir district is full of ancient antiquities. The place is famous for a temple dedicated to the sixty four *Yoginis*. The temple of Somesvara Siva and the Indralatha temple dedicated to Lord Vishnu, although in a dilapidated condition, are other attractions of the site. Recently, Buddhist images have been also excavated from the site. It is presumed that the site had great religious significance. Mohapatra (1954: 75) assigns the temples at Ranipur-Jharial to a period ranging from *c.* 650 to 950 A.D. Belkhandi situated on the confluence of the Tel river and its tributary Utei, at a distance of about 35.41 km from the Kesinga railway station is an important archaeological site of the Kalahandi district. It was first reported by J.D. Beglar after his visit to the place in 1870's. The excavation undertaken at the site brought to light the ruins and lower portion of a *Saptamatruka* temple, *Saptamatruka* images and a large number of cult icons like the images of Hara-Parvati, Lakshminarayana, Ganesh, Kartikeya, Brahma, Garuda, bull, Gajasimhas (lion seated on elephant), Mahesvara, Parvati, Durga, nagas, yogis, etc. On the basis of the artistic finish and iconographic details, the *Saptamatruka* images of Belkhandi can be attributed to the period of the famous Somavamsi kings (Mohapatra 1986: 237).

Jumlagarh and Manikgarh are two ancient forts of the Nuapada district. Jumlagarh, an important military stronghold in the past, is now in ruins. It was a square fort with a width of 268.83 m on each side. The fort had two gates located on the eastern and western sides. The ruined fort walls are still visible in all directions, and are now 3.05 to 3.35 m in height and 2.13 m in breadth. On the northern and southern sides there are four watch towers on each side. Within the fortified area, ruins of residential buildings are noticed. The river Jonk surrounds the fort in all directions. The moat on the eastern side of the fort is paved with dressed stone blocks to facilitate storage of Jonk river water in time of necessity (Mohapatra 1986: 242). The ancient fort of Manikgarh is situated a few kilometres to the northwest of Maraguda at the top of the hill. The fort was designed in such a way that it could offer formidable defence at the time of the enemy's aggression. Adjacent to the fort, on the hilltop, there was a water reservoir, which is in a dilapidated condition at present. The fort is almost in ruins. It is near Manikgarh that the river Jonk enters the Maraguda valley.

Conclusion

Based on the archaeological evidence one can state that in western Orissa, as elsewhere in Indian Subcontinent, there was an efflorescence of urbanization during the Early Historic period. The region had a variegated identity in different historical epochs. The ruling dynasties like the Sarabhapuriyas, the Panduvamsis, the Somavamsis, the Telugu Chodas, the Kalachuris, the Gangas, the Chauhans, etc. established their suzerainty over the area at different stages of history. It was also famous as an important zone of trade. Different religious sects and cultures that flourished over the region significantly influenced the society and life of the people. As a consequence, urban centres like Asurgarh, Buddhigarh, Kharligarh, Sonepur, Maraguda, and Jumlagarh, etc. rose at various strategic points having multifarious dimensions. From the vast archaeological remains with concrete urban features it is evident that western Orissa, in ancient days did not lag behind in respect of urbanization although extensive archaeological spade work is yet to be undertaken to furnish a complete picture.

Acknowledgements

The author expresses his gratitude to UGC for providing financial assistance to undertake a Research Project on Urbanization in Early India.

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A.S. Gaur, *et al., Man and Environment* XXXII(2): 37-40 [2007].
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A Submerged Temple Complex off Pindara, on the Northwestern Coast of Saurashtra

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Abstract

Pindara has been an important religious centre since the early historical period as it has been recorded in several ancient texts. An onshore exploration on the northwestern coast of Saurashtra brought to light the remains of a temple complex presently lying in inter tidal zone of Pindara. There are several temples on the coast of Pindara, which are dated between 7th and 10th century A.D. The archaeological evidence indicates the advancement of shoreline during last 1000 years near Pindara. It is difficult to assign a particular reason for the submergence of temple, however, minor sea level rise and seismic activity might have played a vital role in submerging of the temple.

Introduction

The Gujarat coast has been a focal point of human activities since earliest times, and it played an important role in the emergence and development of the Harappan Civilization (Rao 1973). Being situated in a seismic zone and affected by global natural phenomena like sea level fluctuations the coastline of Gujarat has been drastically changed during the last few millennia. This caused problems for human settlements along the coastal areas, which were either submerged or affected when the shoreline moved offshore by a few kilometres. Marine archaeological explorations along the Indian coast brought to light several such instances from Bet Dwarka (Gaur and Sundaresh 2003), Poompuhar (Gaur and Sundaresh 1998), and Mahabalipuram (Sundaresh *et al.* 2004).

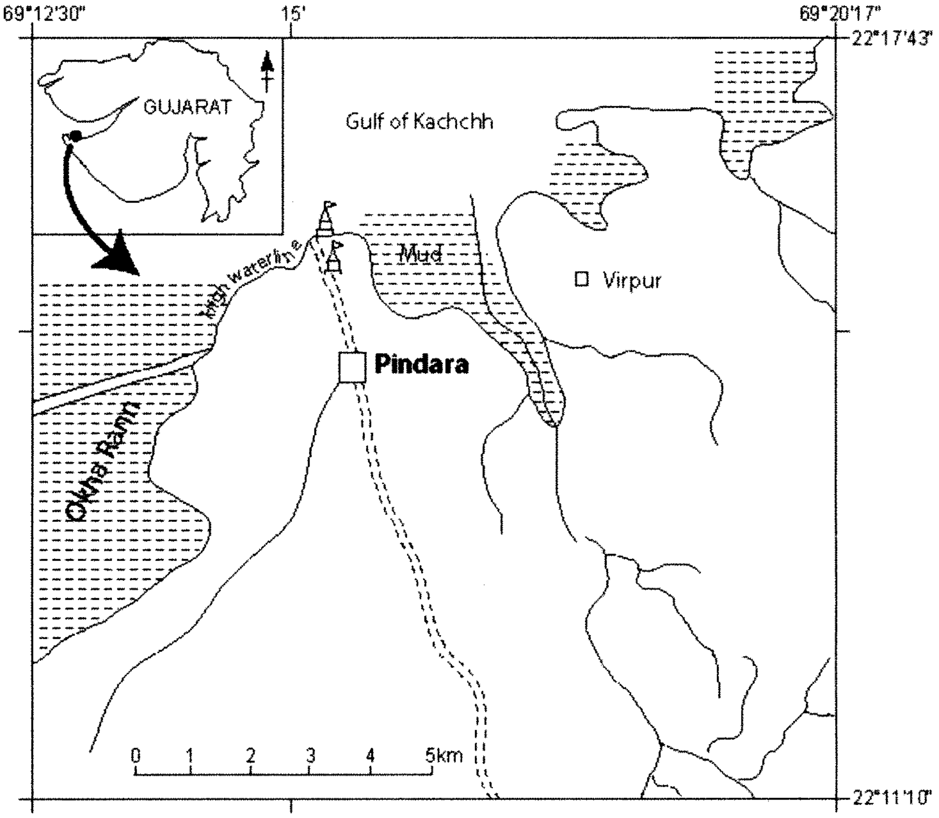

Fig. 1 Location of temple site at Pindara on the Northern Saurashtra coast of Gujarat

Received : 12-6-2007
Accepted : 26-9-2007

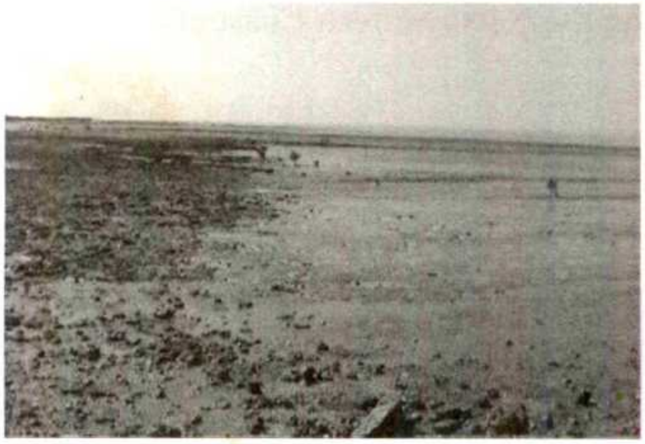

Fig. 2 A large area gets exposed during low tide off Pindara.

An onshore exploration along the northwestern coast of Saurashtra was carried out along the coast of Pindara, a site of historical and religious importance. Around 3 km north of the present village of Pindara, a low lying mound was observed on which a large quantity of pottery lay scattered. A protected temple complex is also situated near to the mound. The coastal area was explored and a few remains were observed. Pindara has been the centre of pearl fishing, and from inter- tidal zone, a large quantity of oyster shells can be collected. The present paper deals with remains of a damaged temple complex discovered during low tide off Pindara in relation with the change in coastline during the recent past.

Pindara is situated about 45 km northeast of Dwarka and is an important religious place, in the Gulf of Kachchh (Fig. 1). To the west of Pindara a vast marshy land known as Okha Rann is situated. The location of Pindara favours a well sheltered area free from open sea waves and comprises of mud flats up to a distance of 2 km from high waterline and a gentle slope. The water depth is at least 1 to 2 m up to a distance of 8 km, while its is more than 5 m for next 4 km. An average tidal range in the region is 1 to 4 m. During low tide a large area get exposed (Fig. 2). Geologically, the formation comprises of the Deccan trap overlain by the Gaj formation which is further subdivided as Ranjitpur limestone (Bhatt 2000). The unit comprises of typical yellow to brown coloured very fossiliferous limestone, which is extensively bored and contains recrystallised shells and fragments of coral. The age of this unit is lower Miocene (Bhatt 2000).

The place was known as *Pinda-taraka-ksetra*, and was famous as a site of pilgrimage as early as the 8th century A.D. (Ansari and Mate 1966). It derives its name from Kund (pond) called Pindatarak, meaning one which causes an offering of a rice ball to float. It is said that it was a city called *Devpuri* existing even before Dwarka and that *Durvasa, Agastya* and other *rishis* resided there. Pindara is mentioned as *Pindaraka* in Mahabharata as a pilgrimage place (*Anushasanparva* 25.57). The ancient site of Pindara is situated about 3 km north of the present village. The oldest archaeological antiquity of Pindara is dating back to Early Palaeolithic (IAR 1965-66). A small-scale excavation at the site yielded Red Polished Ware and pieces of amphorae suggesting an early historical settlement and overseas interaction with the Mediterranean coast (Ansari and Mate 1966). Later on it was an important centre of temple architecture as a huge temple complex was built between the 7th and 10th century A.D. Pindara is also a minor port of Gujarat where presently fishing activities are undertaken.

The temple complex situated on the shore is a protected monument. The temples at Pindara comprise of a square sanctum (*Garbha griha*) and a heavy superstructure over it. Most of the temples face east. The walls of the temples are plain. The most famous among them is a Sun Temple, which is located about 100 m from the high water line.

Archaeological Site

A low mound covered with dense shrubs is situated close to the shore. At a few places foundations of a few structures made of irregular small limestone blocks are exposed. The pottery observed on the surface o the historical period

Submerged Remains

Artefacts are spread in the inter-tidal zone of Pindara in an area approximately 10 x 10 m (Fig. 3, see cover 2). The area of plinth of the temple measures 4.6 x 4.6 m (Fig. 4). The floor area of the temple is well-preserved while the superstructure has been destroyed by the sea, and stone blocks have been either sifted or robbed away. Dressed limestone blocks (measuring 50 x 40 x 22 cm) have been used in the construction of this temple. The temple is oriented in E-W direction and entrance appears to be on the eastern side. The temple was dedicated to Lord *Shiva*, as a *yoni* is present in the middle of the temple complex. The *yoni* measures 40 x 40 cm (Fig. 5, see cover 2). The architectural features of the submerged temple correspond more or less with existing temple on the shore of Pindara. The size of the submerged temple must have been as big as other surviving temples in Pindara group of temples.

Another huge dressed square stone block engraved with yoni is lying north of the present temple (Fig. 6). The size of the block is 100 x 100 x 45 cm and the size of *yoni* part is 40 x 35 cm. The surface of the block is covered with thick growth of barnacles.

Discussion

The archaeological evidence of Pindara suggests an early historical settlement close to the present coast. Earlier

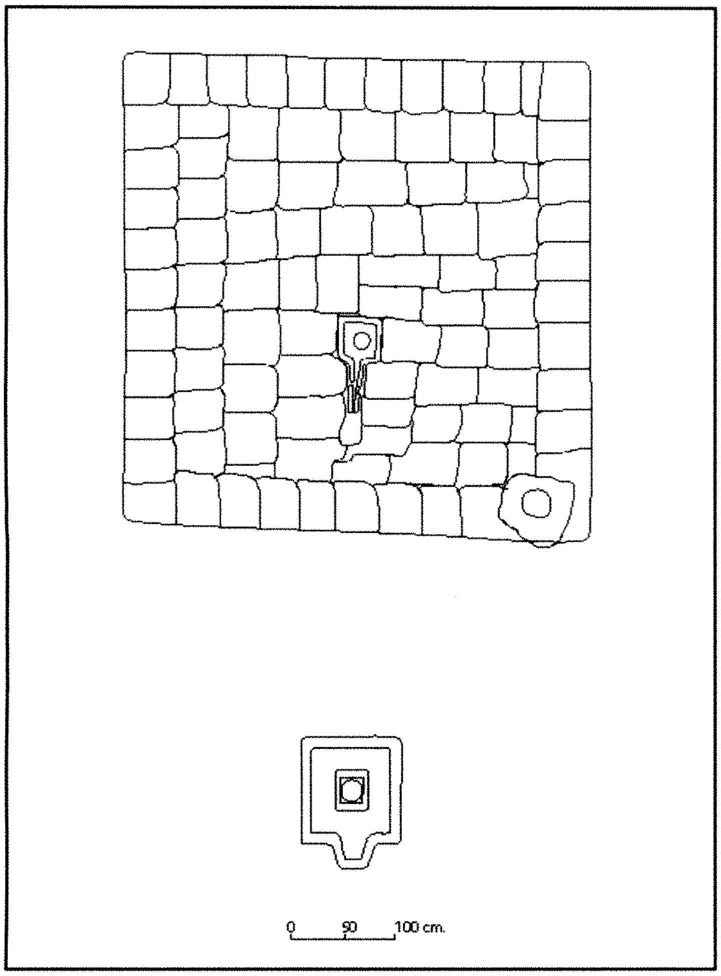

Fig. 4 The size of temple complex in inter tidal zone of Pindara.

excavations yielded the early historical pottery and a few amphorae sherds indicative of overseas trade (Ansari and Mate 1966). Similarly, Dwarka and Bet Dwarka (Gaur *et al.* 2006) were active as maritime centres during the early historic times.

The ancient coastlines of Gujarat have been well recorded on the basis of geological formation and at least 2 higher strandlines were recorded: +20 m and +6 to +10 m dating back to Pleistocene and Holocene, respectively (Patel 1991). The changes in coastlines of the Gujarat have also been studied on the basis of archaeological findings (Gaur and Vora 1999). These suggest that sea level was higher during the mid Holocene. To the east of Pindara there are three small Harappan sites, namely Amra, Lakhabawel and Vasai, located on the tidal rivers, and supposed to be port towns (Rao 1991). However, now tidal water is not reaching up to the site. This indicates a higher sea level during Harappan times (Gaur and Vora 1999).

The recent study of coastline around Bet Dwarka Island, which is close to Pindara indicates a lower sea level during the early centuries of the Christian era (Gaur *et al.* 2007). This is the first instance of the submergence of a temple complex on the northern Saurashtra coast. However, there are other instances of submergence of coastal temple complex dating back to the 6th to 8th century A.D. at Mahabalipuram (Sundaresh *et al.* 2004) on the east coast of India. Similarly, temples dating back to the 11th-13th century A.D. have been damaged by sea near Poompuhar and Tranquebar on the east coast (Sundaresh *et al.* 1997). Close to Pindara an archaeological site was excavated at Bet Dwarka Island and it yielded evidence of lower sea level about 2000 years ago (Gaur and Sundaresh 2003). It suggests that this coast has been unstable during last 2 millennia. The above mentioned evidence indicates that sea level was lower between 2000-1000 years along the Gujarat coast and same rose by about 1-2 m during last 1000 years. It is difficult to assign one particular reason for the submergence of this temple complex. However, it is well known fact that the area is seismically very active (Rajendran and Rajendran 2001) and could have played an important role in the submergence of many sites along the coastal belt of Gujarat. Recently it is being strongly argued that many archaeological settlements must have been

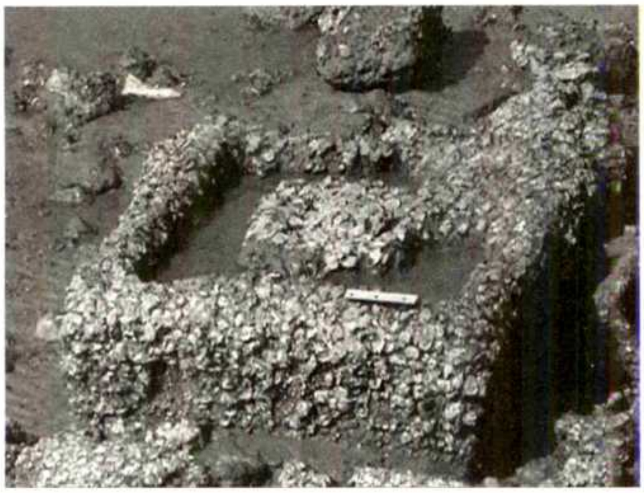

Fig. 6 A square block with *yoni* lying in inter tidal zone of Pindara

destroyed by the Tsunami waves, however, we need additional evidence to establish the fact. This submerged temple complex has certainly opened up a new arena for study of coastline and shoreline changes during last 1000 years of Gujarat.

Conclusion

The northern Saurashtra coast has been occupied since the earliest time and during the Harappan period the coast was dotted with several ports. The coastal site of Pindara was an important port centre that was active during the early centuries of the Christian era. The site finds reference in the ancient texts and it was a religious centre as a number of temples were constructed around the 7th-10th A.D. The pottery reported earlier indicates maritime activities during the historical period. Pindara has been the centre of pearl fishing in the recent past. The discovery of a temple remains in inter tidal zone suggests the coastline movement during the last 1000 years or so. Being situated in seismically active zone the coastline is venerable to changes rapidly.

Acknowledgements

Authors are thankful to the Director, NIO, for permission to publish this paper. Thanks also due to Shri. K.H. Vora, Project Leader, for critically reviewing the manuscript. We thank S.B. Chitari and R. Uchil for illustration.

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P.K. Behera, *et al.*, *Man and Environment* XXXII(2): 41-46 [2007].
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Radiocarbon Dates from the Middle Mahanadi Valley, Orissa

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Abstract

The present work discusses results of recently obtained radiocarbon dates from five excavated archaeological sites, located in the middle Mahanadi Valley of Orissa, and their bearing on the reconstruction of early cultural phases belonging to the first two millenniums before Christ. The results for the first time reveal a continuous record of human occupation of the area right from the Neolithic down to the Early Historic periods.

Introduction

The last three decades have witnessed marked progress in studies on various aspects of the archaeology of Orissa (Basa 1994; Basa and Mohanty 2000; Pradhan 2006). However, till recently, the archaeology of the pre-Christian era of this region was known largely from data amassed through surface explorations, sporadic vertical excavations and comparative studies of excavated /explored cultural remains from different geoarchaeological contexts. Till a few years ago, only two radiocarbon dates were known from the state, one from the metal period burial site of Sankerjang (Yule and Rath 1990: 581-584) and another from the Osteochalcolithic level of Golabai Sasan (Sinha 2000: 322-355). In this respect, a series of radiocarbon dates, recently obtained from the middle Mahanadi Valley of Orissa will significantly contribute towards understanding the past cultural processes of the region from spatio-temporal perspectives.

Stretching across the western part of Orissa, the middle Mahanadi Valley lies between the northern uplands and south-western hilly regions of Orissa highlands (Singh 1971: 754-775). Geographically, it is a transitional zone lying between the Chhattisgarh Plains on the west and the deltaic plains of coastal Orissa on the southeast. Archaeological investigations conducted during the last few years in the area have brought to light a large number of early habitation sites, ranging in date from the Neolithic to the Early Historic periods (Behera 2000-01: 13-34, 2002-2003: 87-103; Pradhan 2000: 99-101, 2006; Badam *et al.* 2001: 828- 830; Singh and Behera 2002: 173-176; Behera and Chattopadhyaya 2004-05: 118-125; Yule *et al.* 2005: 307-318.). Excavations at a few select sites were carried out in the area, during different field seasons, with the primary objective of developing a regional culture sequence through systematic study of excavated materials, studies of their stratigraphic context and chronometric dating. Charcoal samples from different occupational levels of stratified deposits from five excavated sites (Hikudi, Khameswaripali, Badmal Asurgarh, Kumersingha and Kantipuleswar) (Table 1) were collected as per procedure (Gillespie 1984) and submitted for radiocarbon dating. In this paper, a series of ^{14}C dates obtained from different sites with their cultural affiliation will be presented and their chronological implications discussed. Distribution of the excavated sites in the Middle Mahanadi Valley region, from which samples have been collected and dated, are indicated in Fig. 1.

AMS Measurements

The charcoal samples were first cleaned from adhering surface contaminants.To obtain CO_2 for ^{14}C analysis, ~5 mg of pre-treated charcoal samples were taken for combustion. The samples were sealed with CuO and fine Ag wires in evacuated quartz tubes, and heated at 900 °C for ~3hrs. The CO_2 obtained by combustion of the samples was converted into graphite by reducing with ultra-pure hydrogen (H_2) gas in presence of iron (Fe) catalyst. The graphite samples thus formed were pressed into cathode targets for ^{14}C analysis. ^{14}C measurements in the samples were done by accelerator mass spectrometry (AMS) method, using NEC 3MV 9SDH-2 Pelletron accelerator at the Institute of Physics, Bhubaneswar (Ravi Prasad *et al.* 2006). NBS oxalic acid OxI and OxII were used as ^{14}C standards. Ratios of $^{14}C/^{13}C$ were measured by sequential injection of ^{13}C and ^{14}C ions for standards as well as for unknowns. The sample changing was automated recently and about six independent measurements were made on

Received : 16-6-2007
Revised : 19-9-2007
Accepted : 10-10-2007

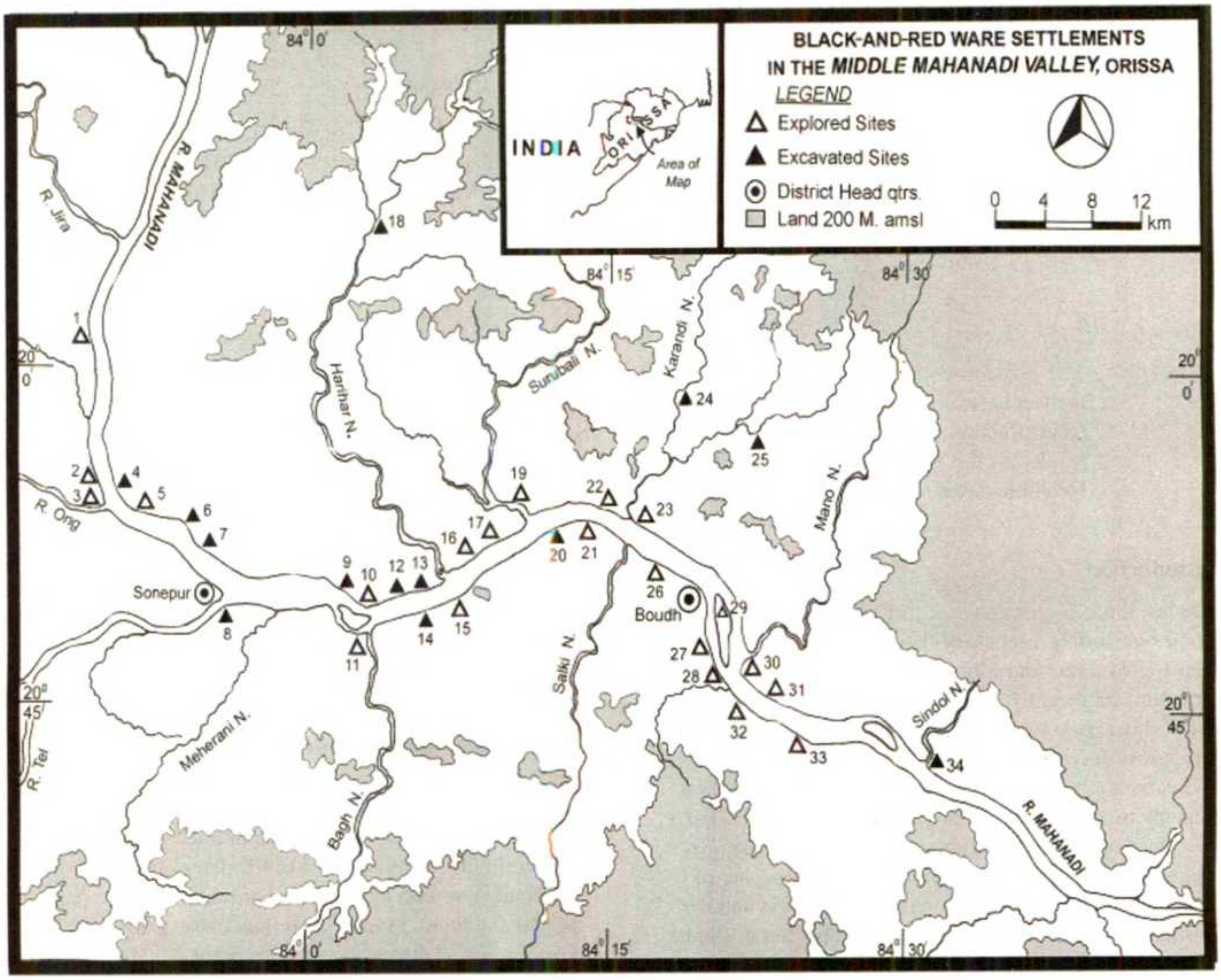

Fig. 1 Map of the middle Mahanadi Valley, showing distribution of early habitations (excavated/explored) associated with BRW potteries and other materials. Sites from which charcoal samples have been dated and discussed in the text are: 7-Hikudi, 9-Khameswaripali, 18-Badmal, Asurgarh, 12-Kumersingha, and 34-Kantipuleswar.

each sample. The results of the ages of nine numbers of samples collected from five different sites are given in Table 2 and are identified by their Lab Code numbers, which start with IP- and follows with the sample numbers. The errors reported are external, which include instabilities of terminal voltage of the accelerator and other tuning parameters during measurement over and above the statistical precision. All ^{14}C-ages were normalized with uniform δ^{13}C of –25‰. The ^{14}C-ages were calibrated with Calib5.1 calibration program. The available results from different laboratories on the samples (having Lab Code with initials PRL- and KIA-) collected from respective statigraphic contexts are also given in the same table for comparison.

Discussion

The calibration results (Fig. 2) are very significant in reconstructing phases of cultural developments during the first two millenniums before Christ in the middle Mahanadi valley region of Orissa highlands and its adjoining areas. For the first time we have a couple of radiocarbon dates from the Neolithic and Chalcolithic levels from Orissa, besides a cluster of dates from different levels of habitation deposits belonging to the Iron Age. The dates closely follow those from similar cultural contexts reported from different parts of India (Agrawal 1982; Agrawal and Kusumgar 1974; Agrawal and Chakrabarty 1979; Possehl 1988 : 169-196; Agrawal and Kharakwal 2003: 186-194, 230-235).

Two dates (Table 2: 1-2) from Hikudi fall within the time bracket, i.e. 2400-1700 B.C., delineated for Indian Neolithic culture (Singh 2002:144). Culturally also,

Table 1: Excavated sites, from which charcoal samples were collected and dated

Name of Site	District	River System	Year	Periods and Cultural Features
Hikudi (20° 52’17”N; 8° 54’15”E)	Subarnapur	The Mahanadi	1999-2000	Period-I (Neolithic) Hand-made, cord impressed and decorated RW potteries; ground stone axes, saddle querns, bone tools, etc. Period-II (Early Historic) BRW, RSW, RW, BSW potteries, iron objects, ring-well, stone beads, etc.
Khameswaripali (24° 6’ N; 83° 0’E)	Subarnapur	The Mahanadi	1996-97	Period-IA(Chalcolithic) Period-IB (Chalcolithic) Period-I:BRW with white painted designs, decorated RSW and BBW,RW potteries; Bone tools, stone and shell- objects, etc. Period-II (Late Chalcolithic-Early Iron Age) Continuation of the above with advanced features Period-III (Iron Age) Continuation of the above with marked degeneration, iron objects, beads of banded agate, etc.
Badmal Asurgarh (21° 6’22” N; 84° 03’ 37” E)	Sambalpur	*Harihar* stream, a tributary of the Mahanadi	2001-02	Period-IA to IC (Iron Age) Plain & rarely Painted BRW, RSW, RW, BSW potteries, iron and bone objects, graffiti-marked potsherds, etc. Period-II (Early Historic) The settlement was fortified, continuation of the earlier features with new trait elements, proliferation of iron objects, large-scale gem-stone bead manufacturing activities, etc.
Kumersingha (20° 51’ 54” N; 84° 05’00”E)	Subarnapur	The Mahanadi	2000-01	Period-IA and IB (Iron Age) Period-II (Early Historic) Same as Badmal except fortification and bead workshop
Kantipuleswar (20° 44’ 35” N; 84° 30’42” E)	Angul	The Mahanadi	2005-06	Period-IA and IB (Iron Age) Period II (Early Historic) Same as Badmal except fortification and bead workshop

material remains from Hikudi (Behera 2006: 26-33) share many common characteristics features with those of the eastern Indian Neolithic tradition in general and north-eastern zone in particular (Sharma 1981: 41-52; Pal 1986; Thapar 1985; Verma 1988; Sant 1991; Singh 1991). The Period-I of Khameswaripali, characterized by white painted Black-and-Red Ware and tools of bone, shell and stone, etc., has yielded two dates 1,555 ± 60 Cal. B.C. (Table 2: 4) and 1,065 ± 66 Cal. B.C. (Table 2: 3) from sub-Period IA and IB, respectively (Behera 2002 : 493-520). Significantly, as regards the date and associated cultural characteristic features, the Chalcolithic period of Khameswaripali demonstrates its contemporaneity with those of Ahar culture, Phase IC (Possehl and Rissman 1992: I, 482) of Rajasthan; Late Prabhas Culture, Period-III (Dhavalikar 1997: 98) and Rangpur culture, Period-III (Bhan 1992: 175) of Gujarat; Malwa culture, Phase-III (Possehl and Rissman 1992 : I, 486-87, II, Table 12, 465) of Madhya Pradesh; Malwa and Jorwe cultural phases of Deccan (Dhavalikar 1997: 155); the Vindhyan (Dhavalikar 1997: 231), Sarayupar region (Chaturvedi 1985: 101-08; Singh 1994 : 33), Bihar (Dhavalikar 1997: 242) and West Bengal (Possehl and Rissman 1992: 481-482) of northern as well as eastern parts of India. Although the earliest level

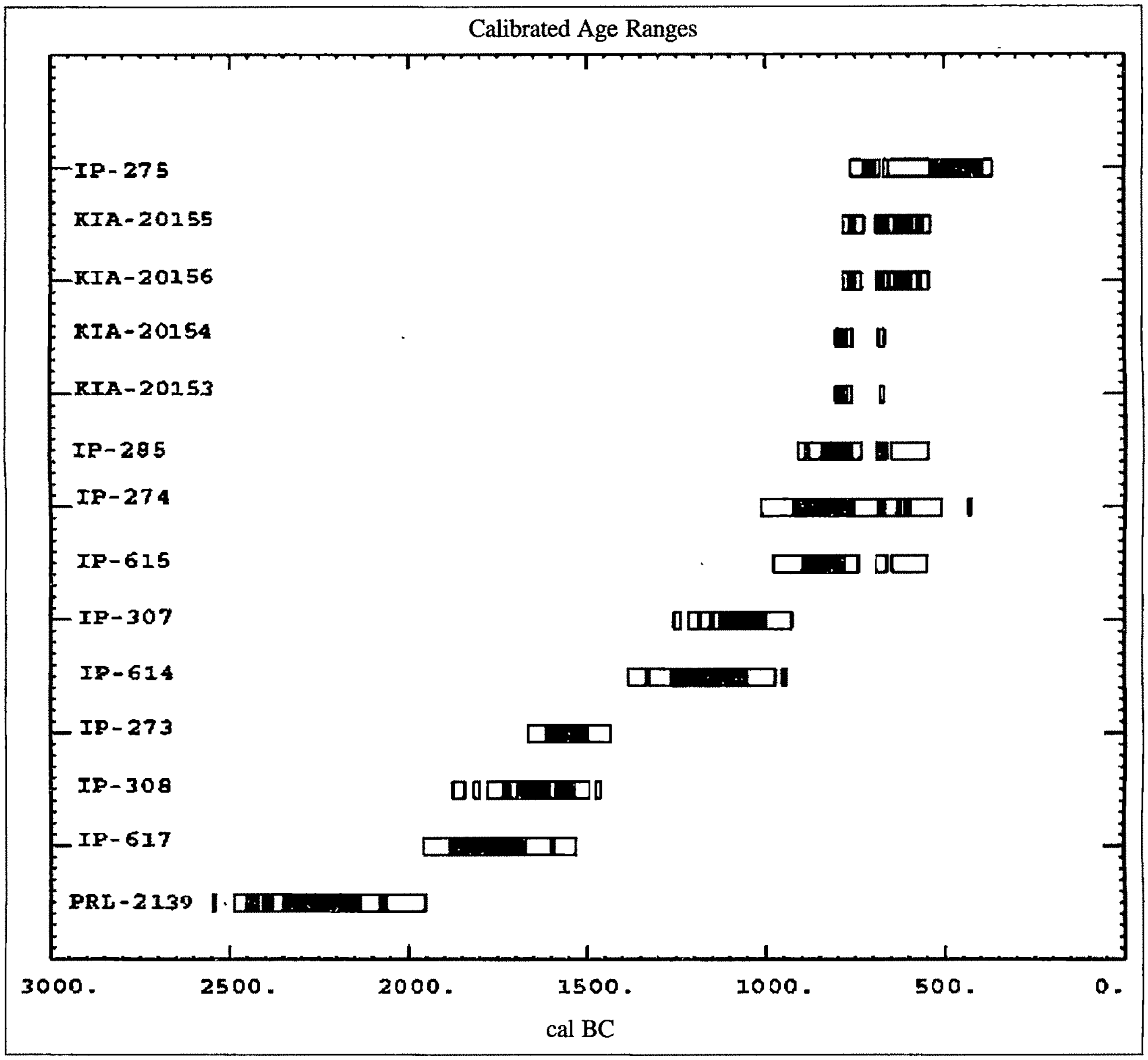

Fig. 2 Calibration of the dating results with Calib 5.1 programme. The confidence limit of the smaller, filled boxes is 68.2%, and of the broader boxes 95.4%.

of the Chalcolithic deposit of Golabai Sasan in Orissa has yielded a date of 4100 ± 100 BP (Sinha 2000: 344), it is too old for any meaningful comparison with that of Khameswaripali. Besides, both sites also differ in their environmental settings and material culture.

As mentioned earlier, for the first time in Orissa, we have a series of calibrated radiocarbon dates from the Iron Age deposits of the middle Mahanadi valley region. From the available dates and concomitant cultural features it appears that by about the beginning of the first millennium B.C., the knowledge of Iron technology was fairly wide spread in the region, albeit in a restricted scale (Behera 2005: 118-125). Significantly, except a lone date of 468 ± 76 Cal. B.C. (Table 2: IP-275) from sub-Period IC of Badmal Asurgarh site, all other dates from Badmal Asurgarh, Kumersingha and Kantipuleswar sites fall within the time range delineated for the 'Early Iron Age' phase in India (Tripathy 2001: 228-247, 2002: 296). Does this suggest an early beginning of the Iron Age in Orissa? The radiocarbon dates presented here are to be considered as a first step in the continuing research process dealing with the archaeology of the pre-Christian era middle Mahanadi valley region of Orissa. More dates are required, particularly from Neolithic and Chalcolithic levels of this area to study the genesis and spread of these cultural phases in the

Table 2: Site, trench and period-wise presentation of radiocarbon dating results

Sl. No.	Site Name	Trench No. / Depth (cm)	Cultural Affiliation & Periods	Lab. Code	^{14}C age (BP)	Calendar Age (B.C.)
1	Hikudi	Tr. II/55	Neolithic (I)	IP-617	3,449 ± 82	1,745 ± 215
2	Hikudi	Tr. II/55	Neolithic (I)	PRL-2139	3,800 ± 100	2,241 ± 109
3	Khameswaripali	Tr. III/75	Chalcolithic (IB)	IP-307	2,888 ± 49	1,065 ± 66
4	Khameswaripali	Tr. I/200	Chalcolithic (IA)	IP-273	3,268 ± 51	1,555 ± 60
5	Badmal Asurgarh	Tr. I/120	Iron Age (IC)	IP-275	2,385 ± 66	468 ± 76
6	Badmal Asurgarh	Tr. I/160	Iron Age (IB)	IP-274	2,642 ± 90	838 ± 86
7	Badmal Asurgarh	Tr. II/45	Iron Age (IB)	IP-285	2,620 ± 59	803 ± 44
8	Badmal Asurgarh	Tr. II/50	Iron Age (IB)	KIA-20155	2,511 ± 23	617 ± 27
9	Badmal Asurgarh	Tr. II/115	Iron Age (IB)	KIA-20154	2,573 ± 22	785 ± 12
10	Badmal Asurgarh	Tr.II/125	Iron Age (IB)	KIA-20153	2,576 ± 22	786 ± 11
11	Kumersingha	Tr. I/230	Iron Age (IA)	KIA-20156	2,514 ± 22	617 ± 26
12	Kumersingha	Tr. II/135	Iron Age (IA)	IP-308	3,352 ± 69	1,648 ± 46
13	Kantipuleswar	Tr. I/520	Iron Age (IA)	IP-615	2,650 ± 70	855 ± 125
14	Kantipuleswar	Tr. I/537	Iron Age (IA)	IP-614	2,946 ± 70	1,180 ± 210

region. Similarly dates are also required from levels related to the transitional phase, between the Iron Age and Early Historical periods, to understand developmental stages in the proliferation of iron technology and its role in the socio-economic processes associated with the second urbanisation in early Orissa in general, and in the middle Mahanadi valley region in particular.

Acknowledgements

The first author thankfully acknowledges the financial and administrative supports he received from the UGC-DRS program of the P.G. Department of History, Sambalpur University for conducting archaeological exploration and excavation in the Middle Mahanadi Valley of Orissa during different field seasons. The author is also grateful to the authorities of the Archaeological Survey India, New Delhi, for providing license to conduct the aforesaid programmes.

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C. Chakrabarti, *et al., Man and Environment* XXXII(2): 47-60 [2007].
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Preliminary Observations on the Growth of Early Historic Settlement of Chandraketugarh, West Bengal – A Geomorphological Approach

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Abstract

The region around the archaeological site at Chandraketugarh/Berachampa, (in the western part), West Bengal comprises a number of Holocene meander belts and tidal plains of successive ages of the Ganga-Brahmaputra delta. The oldest Proto-Padma meander belt (PPM) comprising five sub-belts [PPM.1 (oldest) to PPM.5 (youngest)] holds clues to human adaptation at the site. Early settlers reached the site through the PPM.2 channels and settled on their levee. Subsequent to the complete desiccation of PPM.2 channels, the channels of PPM.3 meander belt formed a point bar complex just north of Berachampa. The PPM.3 channels additionally provided an access to the channels of the Bhagirathi and Ichamati meander belts to the west and east, respectively. Subsequent development of a set of parallel and straight PPM.3 channels branching off from the southwestern corner of the point bar, up to the river Bidyadhari to the south, provided an access to the river. The three rivers thus provided the Berachampa settlers with vital access to the Bay of Bengal. A sudden avulsion of a PPM.3 channel, from the southwestern extremity of the major point bar complex and its subsequent southerly course, close to the eastern end of the settlement, posed a threat of flood. The subsequent decline of the settlement was due to the emergence of a comparatively new east-west trending meander belt (Jamuna), north of Chandraketugarh, connecting the rivers Bhagirathi and Ichamati. As a result, water flowing into PPM.3 channels, from the north, was diverted along this newly formed meander belt (Jamuna) and the PPM 3 channels flowing close to Berachampa gradually dried up. This phenomenon robbed the community of vital river transport routes to the surrounding areas by denying access to Bhagirathi, Ichamati and Bidyadhari rivers. The PPM.3 channels, around Berachampa, and specially the point bar complex to its north degenerated into marshes with stagnant pools of water, leading to the area becoming inhospitable for habitation.

Introduction

Chandraketugarh (22° 41′ N and 88° 42′ E; SOI Topographic sheet No. 79B/10) in North 24 Parganas district, West Bengal, is an important archaeological site in the western part of the compound Ganga-Brahmaputra delta. It is about 38 km north east of Kolkata. It is situated between two major distributaries of the Ganga – the Bhagirathi-Hugli river (to the west) and the Mathabhanga-Ichamati (known as Padma in Bangladesh) to the east. Both distributaries flow into the Bay of Bengal. A derelict but broadly meandering distributary, locally known as the Padma, flows north of the site to join the Ichamati. Another derelict and broadly meandering distributary, locally known as the Jamuna, originating from the river Bhagirathi near Kalyani, and flowing from west to east, also joins the Ichamati river further north of the confluence with the river Padma. A north-south flowing distributary, Bidyadhari, flows 2 km west of the site and meets the Bay of Bengal (Fig. 1).

Regional Geology and Geomorphology

Geomorphologically the area around Chandraketugarh is a part of the Quaternary landscape and falls in the western part of the Ganga-Brahmaputra delta. It is located in the river-dominated upper delta plain near its transition with the tide-dominated lower delta plain. The first stratigraphic information of the area came from the drilling of a well at Berachampa, which revealed a thick succession (about 180 m) of unconsolidated coarse clastic sediments, often gravel-bearing, down to a depth of about 180 m, overlying upper Miocene soft black sticky clay of over 100 m thickness (Deshmukh *et al.* 1973). This late Quaternary

Received : 16-6-2007
Revised : 14-10-2007
Accepted : 1-11-2007

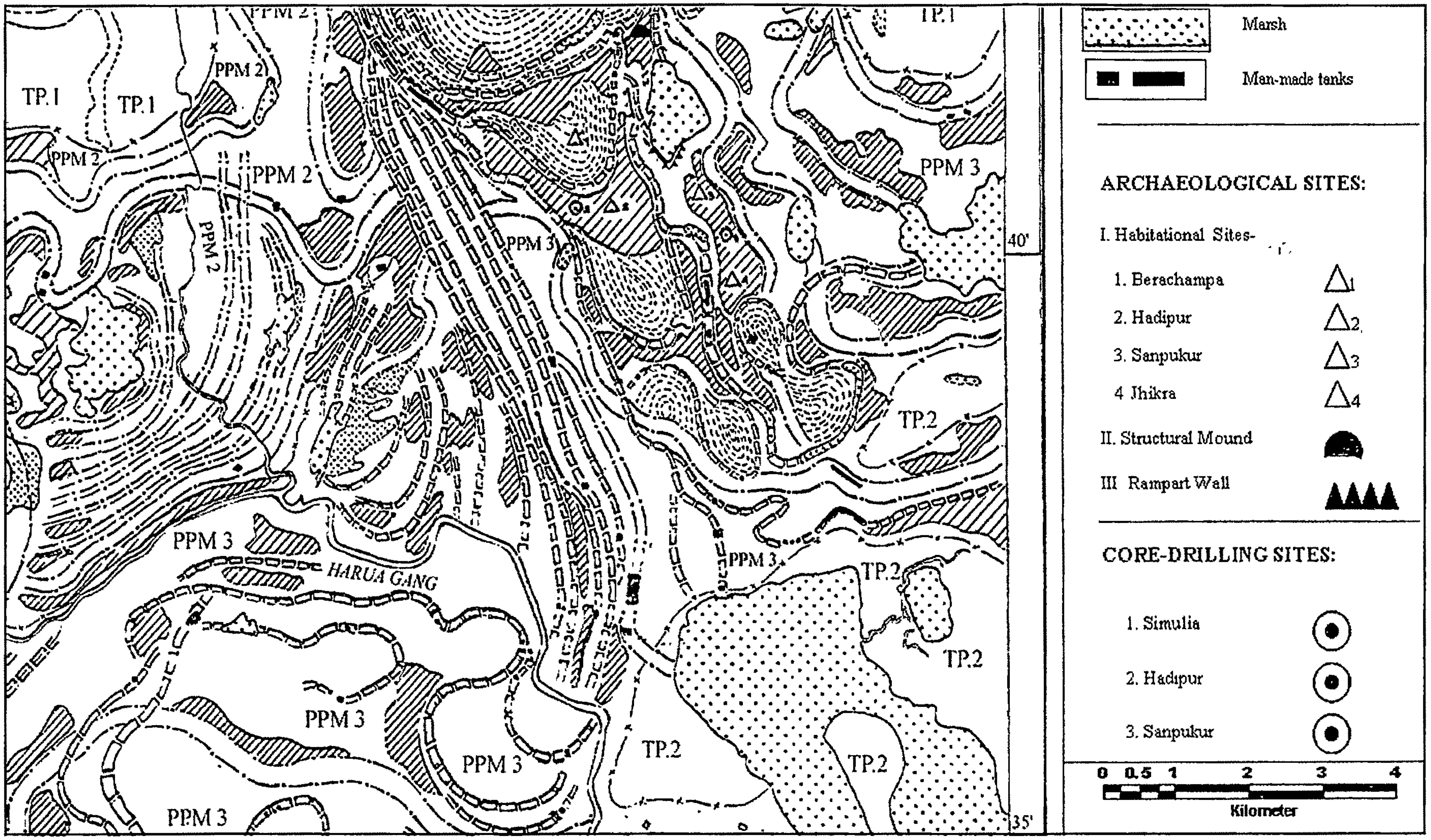


Fig. 1 Area of study

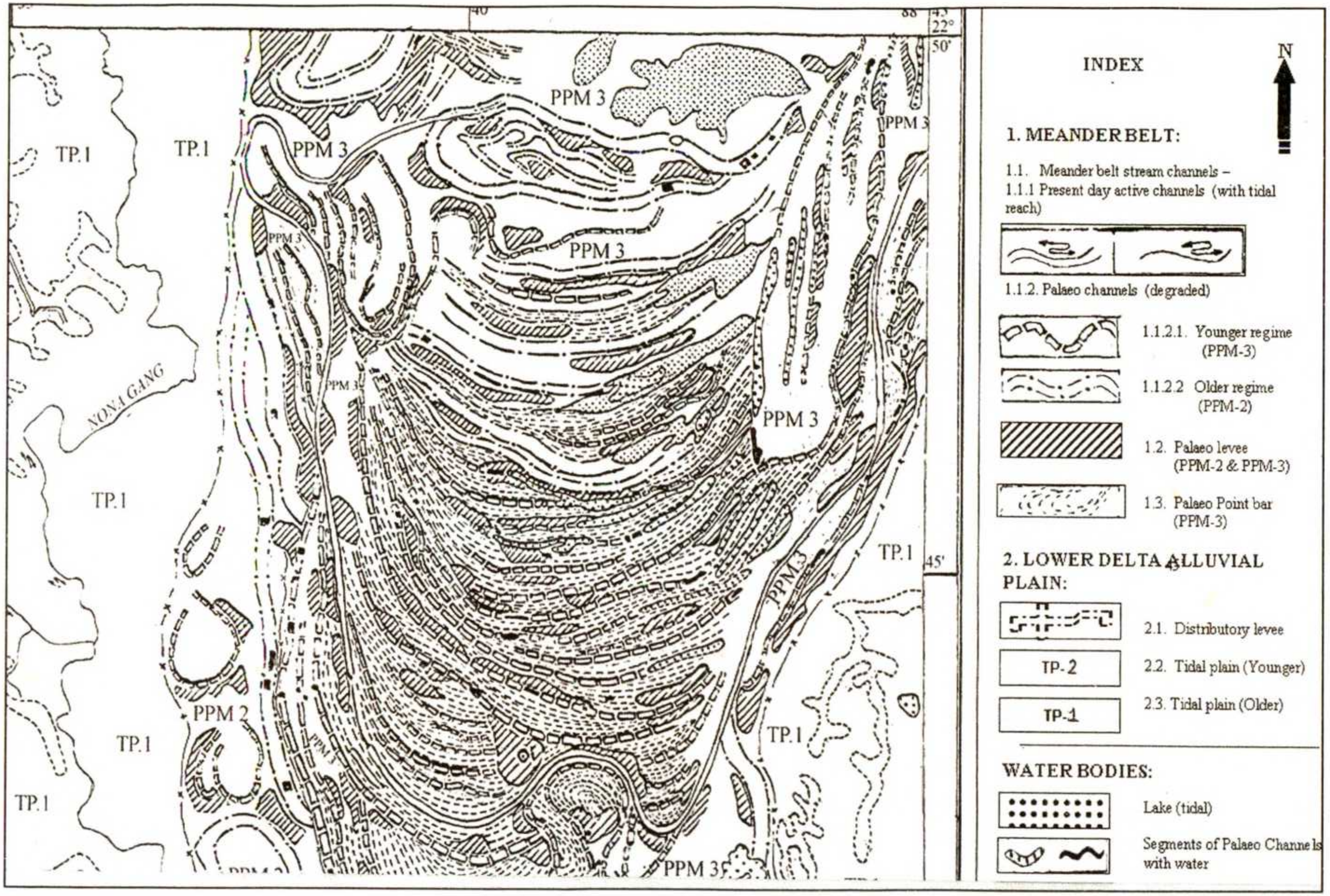

22°
50'
45'
40
88
TP.1
PPM 3
PPM 2
NONA GANG
INDEX
N
1. MEANDER BELT:
1.1. Meander belt stream channels –
1.1.1 Present day active channels (with tidal reach)
1.1.2. Palaeo channels (degraded)
1.1.2.1. Younger regime (PPM-3)
1.1.2.2 Older regime (PPM-2)
1.2. Palaeo levee (PPM-2 & PPM-3)
1.3. Palaeo Point bar (PPM-3)
2. LOWER DELTA ALLUVIAL PLAIN:
2.1. Distributory levee
TP-2
2.2. Tidal plain (Younger)
TP-1
2.3. Tidal plain (Older)
WATER BODIES:
Lake (tidal)
Segments of Palaeo Channels with water

Fig. 1 Area of study (continued)

coarse gravel-bearing succession is a part of a sub-surface north-south trending belt, stretching from Murshidabad district in the north to N-24 Parganas district in the south. The belt represents valley aggradation by a north-south flowing mighty stream consequent upon the rapid rise of sea level after the Last Glacial Optimum with the possibility of complete erosion of early Quaternary sediments along the incised valleys during lowered sea level (Biswas and Roy 1976). Spatially distributed and successive cross-cutting Holocene meander belts seem to be the dominant geomorphic features in the upper delta plain of the Ganga-Brahmaputra delta with the channels currently carrying more than 1 billion tones per year of sediment with a very high discharge of about 1 million cumec (Coleman 1969). Regionally the area around Chandraketugarh is characterized by the Proto-Padma, Bhagirathi and Padma meander belts (Centre for Study of Man and Environment 1989). Bhagirathi and Padma meander belts are made up of three and five sub-meander belts, respectively. The Proto-Padma meander belt is the oldest and is cut by meander belts of the rivers Bhagirathi and Padma. Specifically Chandraketugarh is located on the oldest identified meander belt (named Proto-Padma Meander belt or PPM in short). Sub-surface of the PPM is underlain by the same coarse clastic sequences encountered in Berachampa and similar sequences reported by Biswas and Roy (1976) further north.

The area extending south of Chandraketugarh up to the sea does not show any trace of meander belts. The valley trenching and later in-filling is restricted along traces of major meander belts; and thus sub-surface Pleistocene deposits in these areas are preserved (Hait *et al.* 1996; Stanley and Hait 2000; Stanley *et al.* 2000). Pleistocene beds are overlain by relatively thin fine-grounded Holocene deposits with an increasing thickness ranging from 11.3 m (Salt Lake), 43.5 m (Canning) to Pakhiralaya (greater than 50 m).

Archaeology

The site was visited by A.H. Longhurst (ASI AR 1922-23) and later by R.D. Banerjee who pointed out it as an early historic settlement. The site is roughly 2 km^2 in extent and constitutes the localities of Berachampa, Khanna Mihirer Dhipi, Itakhola, Noongola, Hadipur, Gazitala, Berer Bil and Shanpukur. Since a major part of the site is buried under alluvium (Chakraborty 2000), it is not represented by any visible mounds save for two stretches of rampart (1.5 and 0.5 km, respectively), and a structural mound at Khanna Mihirer Dhipi. The original shape of the rampart is now difficult to determine as part of it is still buried (Fig. 2). It is a rather L-shaped or U-shaped structure enclosing an area known as 'Berer Bil' to the south and the west. The rampart, according to the excavators, was constructed in *c.* 1st century B.C. and reinforced in *c.* 1st century A.D.

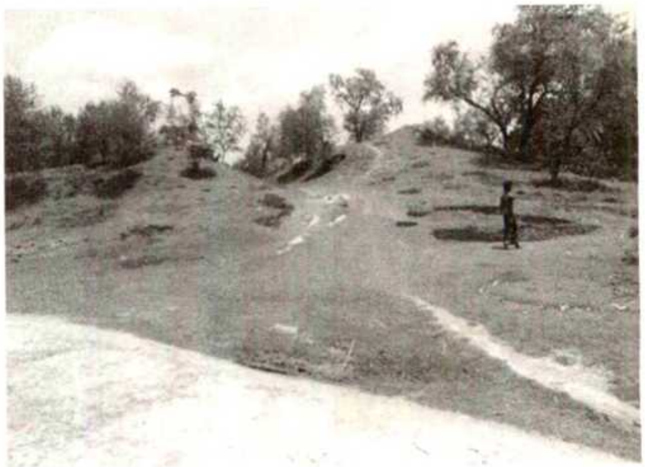


Fig. 2 The rampart wall

A moat resulting out of digging of the rampart acted as an additional defense (IAR 1964-65: 52), which was constructed with mud and rammed with potsherds. An interesting brick ramp of rammed concrete belonging to pre-Gupta period was also constructed and this lay at the base of the mud rampart. Evidence of terracotta drain pipes belonging to the Maurya-Sunga period was also found. A mound of about 5 m, locally known as Khana Mihirer Dhipi, northeast of the rampart wall, is another feature visible at the site. The site was excavated by Asutosh Museum of Indian Art, Calcutta University between 1956-57 and 66-67 by K.G. Goswami and later by D.P. Ghosh and C.R. Rowchoudhury (Fig. 3). Excavations were carried out at several localities, including Khana Mihirer Dhipi, Itakhola Noongola, Berachampa and Hadipur. Berer Bil, Gazitala Shanpukur, and some other localities were subsequently explored and yielded antiquities belonging to different periods (Fig. 1).

Period I is represented by a thin layer of Pre-NBPW, dating to around 600-500 B.C. The excavator initially claimed the presence of PGW at the site which has not

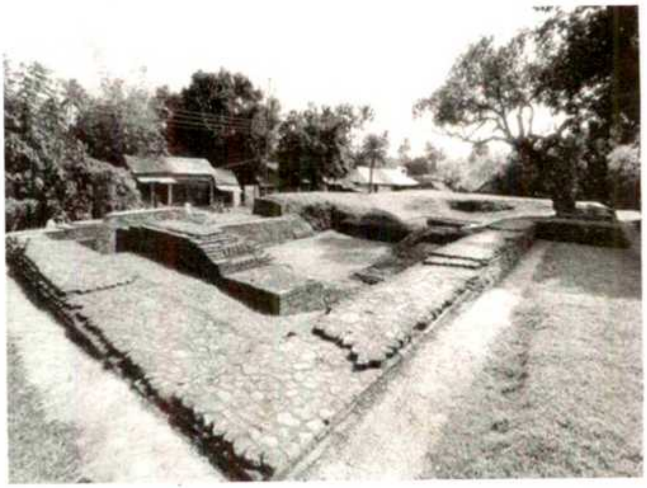


Fig. 3 Khana Mihirer Dhipi

been proved during later period. It must also be mentioned that the excavations did not reach the virgin soil. Based on the presently available data the chronology of the site cannot be placed much before 4th century B.C. Period II belonging to *c.* 4th century B.C. – 2nd century B.C. yielded NBPW, Black Slipped Ware, Grey Ware, Rouletted Ware, Red Ware, fragmented pieces of ivory and copper antimony rods, punch marked copper coins, un-inscribed cast copper coins, a fairly good number of terracotta objects, and a large number of beads and seals. Period III is contemporary with the Sunga-Kushana period, apparently the most prosperous, and can be placed between the 2nd century B.C. and 3rd century A.D. It yielded fine pieces of diagnostic Rouletted Ware, fine red pottery with stamped design, grey pottery and finely moulded terracotta figurines. Period IV is ascribable to Gupta and late Gupta times (*c.* 3rd – 6th century A.D.). It yielded typical seals and sealings, terracotta objects and stamped and moulded pottery. The most important find of this period is the remains of a massive *sarvata-bhadra* type of brick temple with re-entrant angles. The date of the temple has been ascribed later by scholars to the Pala period (Saraswati 1976). The archaeological evidence of Period V, belonging possibly to the Pala phase is very limited (800-900 A.D.). Period VI, the post-Pala period, revealed awls, bone gaming dice, carnelian beads and pottery lamps. Period VII was highly disturbed. Period VIII (mentioned for only one season), which ends around the 10th century A.D. was associated with a small brick temple while some of the later structures also included two votive stupas.

An early Settlement belonging to approximately the 3rd century B.C. was found at Berachampa, Khanna Mihirer Dhipi, Itakhola and Noongola. Settlements belonging to the 1st century A.D. were noted at Hadipur, apart from other mentioned locations. The structures of the early phase (pre-Gupta) are invariably made of wood and provided with roof tiles. Burnt bricks were introduced only during the Gupta Phase. Excavation reports published in the IAR are rather inconsistent as far as periodisation is concerned. It is evident that the excavators faced problems in correlating different periods, dated with the help of associated artefacts and not through absolute dating methods now available to the archaeologists. The development of settlement localities at Chandraketugarh seems to have an uneven history. Whether this is a result of later disturbances is not clear. For instance, the post-Gupta levels noted at Khana Mihirer Dhipi are absent at the nearby site of Itakhola (IAR 1963-64: 65). Here also, the excavators note that Period IV at Itakhola possibly belonged to the Gupta period, while the same Phase at Noongola revealed a thick flood deposit of sandy clay. The excavators write 'No such deposit was met with at Itakhola due to the disturbed condition of the upper strata' (IAR 1965-66: 60). Future archaeological investigations should focus on the complicated formation processes operating at the site.

Sengupta (1997) opines that the period 2nd century B.C. – 2nd century A.D. could have been the most flourishing period at the site. The site could have functioned as a port and urban centre as opined by various scholars (Mukherjee 1993-94; Chattopadhyay 1993-94). Roychoudhury and also Chakraborty have dealt with the problem of classification and chronology of artefacts like terracottas and beads. The remarkable aspect of this site is the richness of terracotta objects-figurines, plaques etc, exhumed from the site along with objects carved out of ivory. These objects are largely the reason for continuing interest of the archaeological community in this site. Little is known about the 'setting' of the site, which leads one to the moot question of why this location was chosen and why it continued to be the largest site- in terms of spatial extent, within the entire delta. These research problems have been formulated by keeping the above question in mind.

Definition of the Problem

Chandraketugarh is a buried site with only few structural remains partly visible on the ground. The landscape around the site has also changed and the remnants of old landscapes are present in the form of paleo-channels, paleo-levees and paleo-point bars.

The geomorphological signatures of paleo-landscapes have been discussed before (Chakraborty 2000). However the relation (in terms of chronology) between paleo-landscape features like point bars, levee and channels and their relation to the archaeological site has never been explored. The present landscape of derelict streams poses the question of how a large settlement like Chandraketugarh could have functioned in the past. For this, the evolution of landscape during late Holocene landscape period needs to be studied properly.

Objective

The objective of the present investigation is to evolve a new methodology of working out the history of landscape development during late Quaternary period around the major archaeological site at Chandraketugarh located in a very dynamic fluvial landscape of the large compound Ganga-Brahmaputra river delta.

Methods of Investigation

A large fluvial system like the Ganga-Brahmaputra river develops very distinct meander belts of major distributaries in the upper delta plain. The meander geometry is appropriate to the corresponding hydraulic parameters of the distributary system, like the slope of the channel, its water and sediment discharge and the texture of the sediment load of the system. Each meander belt builds up an alluvial ridge over a given period of time in the upper delta plain. Two situations may arise with time. In the first situation, when there is no substantial change in hydraulic parameters, the meander belt loses its efficiency to sustain the fluvial system after a given time, due to net deposition and the belt is ultimately abandoned. A new meander belt is established adjacent to the preceding meander belt by partly eroding and/or overlapping the earlier belt. A cross-cutting relationship between these two meander belts is thus established and the two meander belts are often preserved in the Quaternary landscape of large fluvial systems showing a relative chronological sequence between the two. In the second situation, after a given time, there may be a change in the hydraulic parameters, often due to diversion and/or capture of any of the channels of a distributary of the fluvial system. This will lead to development of a new meander belt with changed meander geometry appropriate to the newly established hydraulic parameters, again cross-cutting and/or overlapping the preceding meander belt. Such a new meander belt with changed meander geometry, often cross-cutting the preceding meander belt is also preserved in the Quaternary landscape of large fluvial systems and can be mapped along with earlier meander belt establishing a relative chronological sequence. In a large fluvial system like the Ganga-Brahmaputra river, mapping of meander belts of major distributaries based on the principle of cross-cutting relationship and changed meander geometries, has been found to be a convenient method that leads to establishing the history of landscape development, and for possible correlation with the rise and fall with human settlements in the region. Such a study in the Chandraketugarh area has been found to be best carried out through visual interpretation of satellite imagery (PAN) (in 1:250,000) and aerial photographs (in 1:20,000) because of the geometry of the meander belts. Other smaller fluvial system may perhaps require larger scale imagery than those used in the present investigation. In particular the methodology of the study involves:

1. Mapping of different meander belts of the chosen Quaternary landscape, by identifying contrasting fluvial morphological patterns on plan, from satellite imagery (scale 1:250,000).
2. Establishing the relative chronology of identified meander belts from their cross-cutting relationships.
3. Relating identified meander belts in terms of activation/deactivation of the distributary channels of the delta.
4. Explaining the establishment and subsequent decline of a particular meander belt in terms of the growth/development history of mapped meander belts and their inter-relationship with preceding and succeeding meander belts.

In the Indian context this is a new and innovative methodology that has not been applied previously for interpretation of past human settlements in a dynamic fluvial system. Similar mapping has been however attempted elsewhere to interpret prehistoric settlement patterns by placing them on geomorphic maps that defines the distribution and age of physical landform (Ravesloot and Waters 2002-04).

Results

A regional geomorphological map on 1:250,000 scale was prepared covering a larger region to place the Chandraketugarh area in the perspective of regional geomorphology of the western part of the Ganga-Bhagirathi delta. For the first time, PPM has been subdivided into several meander belts having distinctive morphological signatures and relative cross-cutting relationships (Fig. 4). The tidal plains have been shown to be made up distinct separate units of different ages. Moreover, a detailed geomorphological map of the area surrounding the Chandraketugarh sites has also been prepared on 1:50,000 scale to depict the present and palaeo-geomorphic land forms (Fig. 5).

Besides gathering geological and geo-morphological field evidence, traverses were also undertaken for precise identification of sites, and for locating drill holes to obtain undisturbed core samples of sub-surface Holocene sediments. In total, 90 core samples were obtained from three drill holes, with each hole yielding 30 samples. Two core samples have been sent for obtaining dates. Others were preserved for detailed studies in the future.

Proto-Padma Meander Belt

This is the oldest and most-extensively developed meander belt and occupies the central part of the area bordered by the meander belts of the Padma (north), Bhagirathi (west) and Ichamati (east) rivers. The southern boundary is formed by tidal plains. This meander belt comprises several stages. On the basis of visual interpretation of satellite imagery (1:250,000 scale), it can at least be subdivided into 5 sub-belts (stages) of differing ages (PPM.1 to PPM.5). The categorization has been done primarily with the help of contrasting plan form pattern of river channels, and the cross-cutting relationship between these stages offered clues to their relative chronology. Out of these five stages, PPM.2 stage covers the maximum area and extends towards north far beyond the present study area. The PPM.3, PPM.4 and PPM.5 stages developed as southward extensions of PPM.2 drainage and originated from a region lying to the south of the west-to-east-trending Jamuna meander belt. This extended southwards in conformity with the regional slope towards the Bay of Bengal. Essential details about the Proto-Padma Meander Belt are summarized Table1 and depicted in Figure 6. The relative chronology between the meander belts and tidal plains is summarized in Table 2.

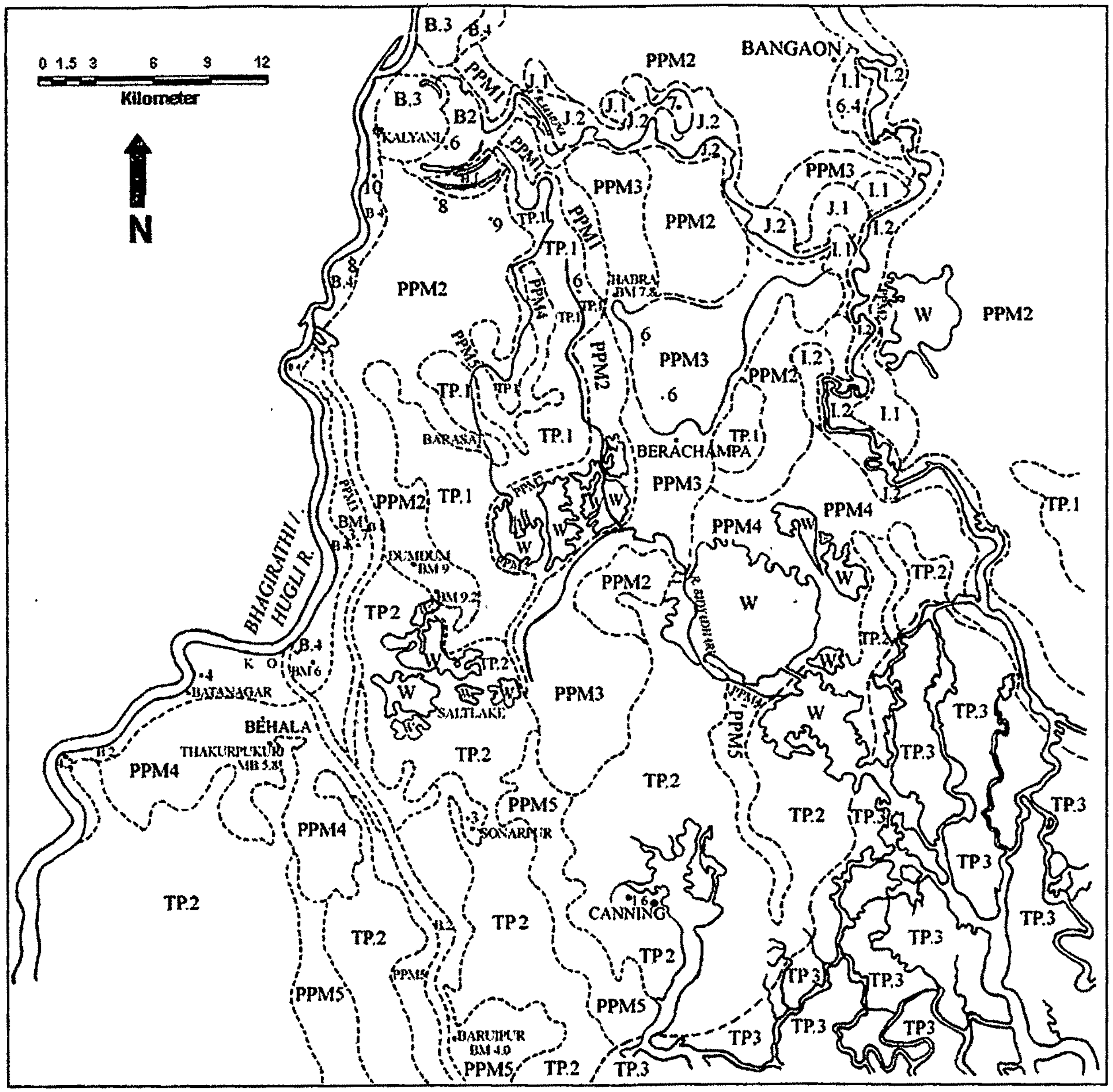


Fig. 4 Regional geomorphological map in and around Berachampa

INDEX

UPPER DELTA PLAIN		LOWER DELTA PLAIN	
Meander belts	Map Symbol	Tidal plains, distributary levee and interdistributary Brakish water marsh	Map Symbol
1 Bhagirathi -4 2 Ichamati -2 3 Jamuna -2	B.4 I.2 J.2	• Present day active -	TP 3
1 Bhagirathi -3 2 Ichamati -1 3 Jamuna -1	B 3 I.1 J.1	• Older (Semi active)- • Wet-Lands / Lakes -	TP 2 W
1 Bhagirathi -2 2 Bhagirathi -1	B 2 B.1		
1 Proto-Padma : 9.1 Sub belt – 5 9.2 Sub belt – 4 9.3 Sub belt – 3 9.4 Sub belt – 2 9.5 Sub belt – 1	 PPM 5 PPM 4 PPM 3 PPM 2 PPM 1	• Oldest (moribund) - • Wet-Lands / Lakes -	TP.1 W

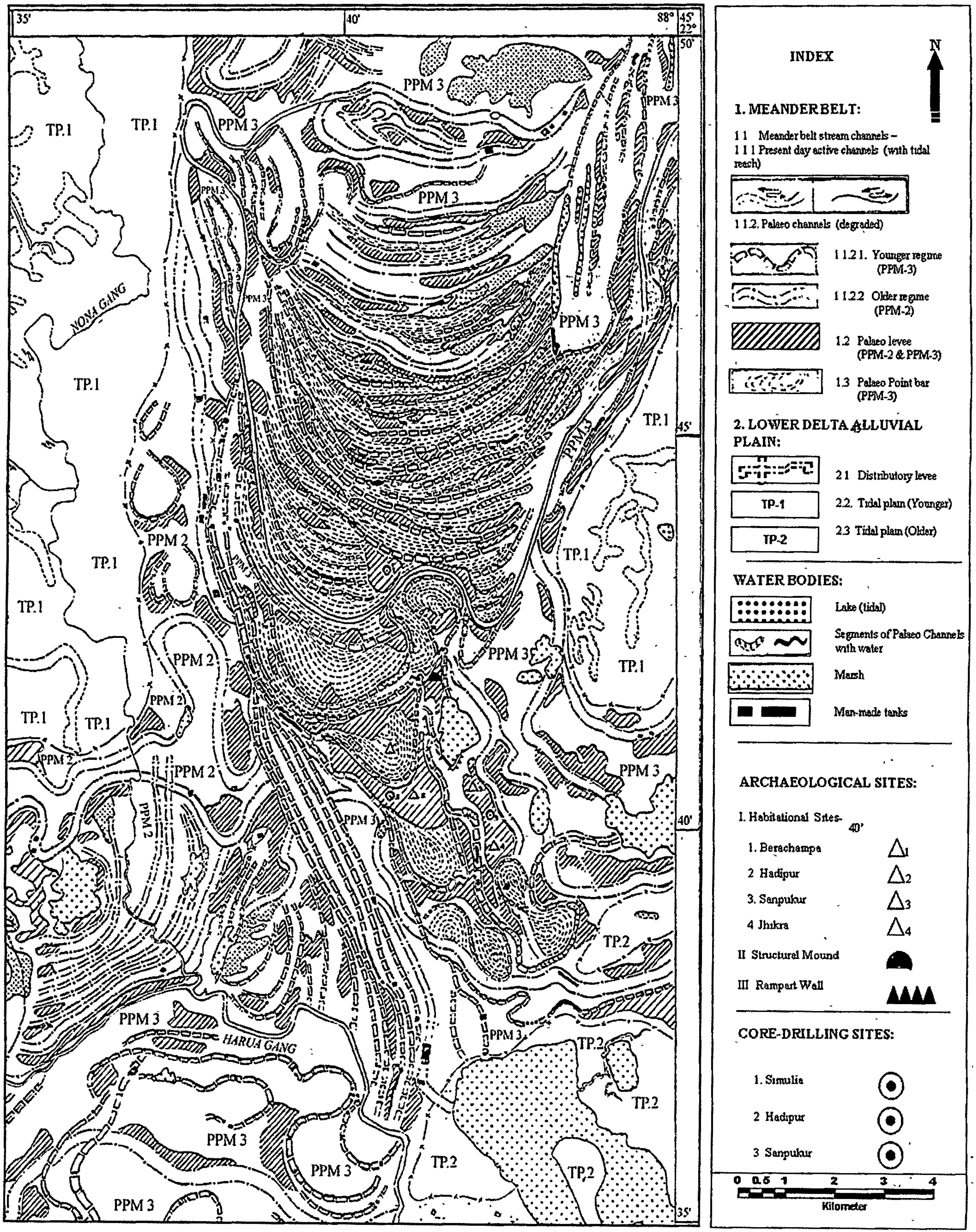


Fig. 5 Detailed geomorphological map in and around Chandraketugarh

Table 1: Details of different sub-belts of the Proto-Padma Meander Belt

Sub-belt	Description	Channel Pattern
PPM.5	Occupies less extensive area and occurs as extensions of PPM.3, forming low narrow sinuous linear tracts (alluvial ridges)	Individual channels are rarely recognisable, excepting for a few palaeo-channel scars. The channels are completely in-filled with sediment. The supply of water from the catchment is low.
PPM.4	Occupies a fairly extensive tract and occurs as an extension of PPM.2 and PPM.3 drainage systems, and forms a fluvial plain by lateral migration of numerous palaeo-channels. Excepting the palaeo-channels the associated flood plains and other fluvial land forms too small to be mapped from imagery	Numerous tightly compressed in-filled narrow highly meandering channels. The cut-off meander loops are generally small and rarely exceed 500 x 500 m in size. Drainage density is very high. Channels carried a low volume of water. There is an overall decline in the supply of water from the catchment.
PPM.3	Third oldest member of PPM. It originates in the north from the southern boundary of Jamuna meander belt and cutting across PPM.2 occurs as an inset within it. The unit comprises numerous in-filled and/ or partially in-filled, dry, narrow river channels with small narrow elongated levees. Floodplains are conspicuously absent. The channels form an enormous palaeo-point bar north of Berachampa. South of Bidyadhari river which cuts across the PPM.3, the straight channels give place to a strongly meandering pattern with moderately large meander loops having a large radius of curvature. The drainage in this part of PPM.3 appears highly disjointed and disoriented ("deranged" drainage). Possibly owing to ground uplift or tilting. Within the PPM.3 belt, channels have practically obliterated the earlier channels of PPM.2 and modified/ dissected the PPM.2 levees.	Numerous rectilinear, mutually parallel, narrow channels are seen. There is an extremely high drainage density. The majority of cut-off meander loops are moderate in size, occupying an area whose length and width ranges from 1.0 to 2.0 km, excepting the large cut-off meander loop, located to the north of Berachampa, which extends over a distance of 8.0 and 12.0 km in east-west and north-south directions, respectively. The supply of water from catchment is reduced as compared to PPM.2 stage.
PPM.2	Second oldest and most extensively developed member of PPM. The unit comprises alluviated (in-filled) segments of channel-remnants of migrating palaeo- meander channels with associated large levees, in-filled crevasse splays and palaeo-flood plain deposits. This unit has the appearance of a stabilized alluvial ridge complex, built up by lateral accretion of channel and flood plain sediments, and forms the highest topographic surface (8-9 m AMSL). The southward flowing rivers constituting PPM.2 gradually dried up as these were cut-off by the establishment of the easterly flowing Padma (the main Padma river).	A large number of wide, gently meandering river channels with large meander loop having a high radius of curvature, often forming ox-bow lakes/ wetlands. Drainage density moderately high. The cut-off meander loops are generally large and cover an area whose length and width ranges from 5.0 to 6.0 km. The channel geometry suggests that the channels carried a large volume of water derived from the catchment.
PPM.1	Oldest member of PPM; occupies a small area in the northwestern fringe of PPM. This unit is overlapped and obscured by PPM.2 channels in the rest of the area	Few extremely small narrow crescent shaped ox-bow lakes (0.5 km in size), few indistinct channel remnants. Small circular depressions with standing water are common. The drainage density is low. The Supply of drainage water from catchment is low

Bhagirathi Meander Belt

It occupies the western fringe of PPM. Four stages have been recognized (B.1 to B.4). The oldest stage (B.1) cut into the oldest members (PPM.1 and PPM.2) of the Proto-Padma Meander Belt near Kalyani. The B.2 stage is represented by a completely in-filled, low sinuosity, palaeo-channel. The B.3 stage is also represented by a partially in-filled, low sinuosity, moribund palaeo-channel, within which mutually parallel rectilinear thalweg scars (some of which still contain water) can be mapped from aerial photos (1:20,000 scale). The B.4 stage represents the present-day active channel of Bhagirathi/Hugli river with its prominent levee. B.3 and B.4 stages have been cut-off by P.4 stages whereas the B.1 stage has been cut off by P.1 stage of the Padma meander belt. The B2 stage has been cut both by P.1 and P.4 stages.

Ichamati Meander Belt

It occupies the eastern margin of PPM and three stages have been recognized. The I.3 stage represents the present day active channel with its narrow, restricted flood plain. Towards the north the river channel is extremely narrow and displays a high degree of sinuosity with tight meander loops. This pattern abruptly changes to a rectangular pattern with a straight wide channel with right angle bends. The point from which this change in pattern occurs probably represents a pre-existing tidal channel presently called the Jhila river. The I.2 stage is represented by isolated terraces displaying wide, crescent shaped ox-bow lakes of wide channel. These ox-bow lakes contain a huge amount of water and represent cut-off meander loops of older channels which strongly differed in their planimetric geometry from the channel pattern displayed by I.3.

Jamuna Meander Belt

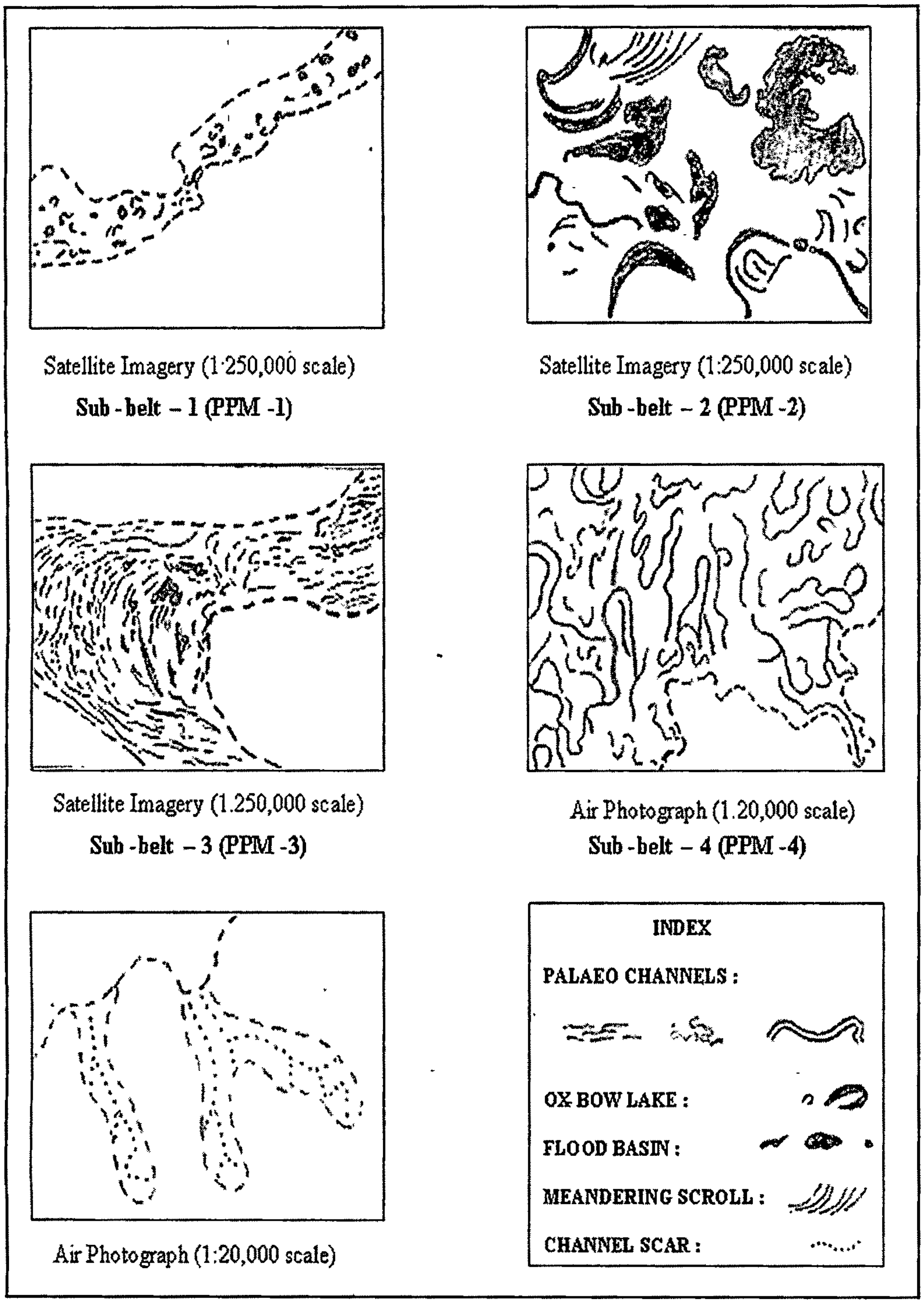
This east-west flowing meander belt originated from the Bhagirathi/Hugli river near Kalyani, cuts across PPM.1, PPM.2 and PPM.3 meander sub-belts and joins the Ichamati river. The channels were narrow and showed meander loops with a high radius of curvature in J.1 stage which subsequently gave place to a less sinuous pattern in J.2 stage. Though presently moribund, it derived its water during the active phase from the B.2 or B.3 stage of Bhagirathi River.

Padma Meander Belt

Four stages of the Padma meander belt have been recognized (P.1to P.4) of which P.1 is oldest and P.4 represents the recent flood plain. The relationship of the Padma meander belt with that of the Bhagirathi and Proto-Padma meander has already been discussed and can be seen in Figure 7.

Table 2: Correlation between meander belts and tidal plains

Upper Delta Plain		**Lower Delta Plain**	
Meander Belts	**Map Symbol**	**Tidal Plains, Distributions levee and Interdistribitary Blakish Water Marsh**	**Map Symbol**
1. Bhagirathi – 4	B.4	• Present-day (active)	TP.3
2. Ichamati – 2	I.2		
3. Jamuna – 2	J.2		
4. Bhagirathi – 3	B.3	• Older (Semi Active)	TP.2
5. Ichamati – 1	I.1		
6. Jamuna – 1	J.1	• Wet–Lands / Lakes	W
7. Bhagirathi – 2	B.2		
8. Bhagirathi – 1	B.1		
9. Proto-Padma			
9.1 Sub belt – 5	PPM 5	• Oldest (moribund)	TP.1
9.2 Sub belt – 4	PPM 4		
9.3 Sub belt – 3	PPM 3	• Wet–Lands / Lakes	W
9.4 Sub belt – 2	PPM 2		
9.5 Sub belt – 1	PPM 1		


Satellite Imagery (1·250,000 scale)
Sub-belt – 1 (PPM-1)

Satellite Imagery (1:250,000 scale)
Sub-belt – 2 (PPM-2)

Satellite Imagery (1.250,000 scale)
Sub-belt – 3 (PPM-3)

Air Photograph (1.20,000 scale)
Sub-belt – 4 (PPM-4)

Air Photograph (1:20,000 scale)

Fig. 6 Characteristic patterns of fluvial land form features comprising different sub-belts (Stages) of Proto-Padma Meander Belt, as observed in satellite imagery and aerial photograph

Tidal Plains

An extensive tidal plain has been mapped as the oldest geomorphic surface (TP1) on the ground in the northernmost part of the study area. It is characterized by well developed in-filled palaeo-tidal creeks displaying a rectangular pattern in the form of a linear relatively high ground (now occupied by villages) in an otherwise featureless terrain (now represented by cultivated lands) developed on palaeo-tidal mud flats (Fig. 5). The tidal creek and distributary channel systems are now completely obliterated. At present, only two channels, Nona Gang and

Sunti River both having tidal flows, drain the northwestern sector of the study area. Inter-distributary or inter-tidal marshes on extensive mud flats were perhaps the dominant morphological element occupying large parts of this part of the tidal plain before the land was reclaimed for cultivation.

An extensive tidal plain (TP.2) has been mapped as a relatively young geomorphic surface (compared to the TP1) expending seaward in the southeastern corner of the study area. This is a featureless geomorphic surface characterized by a relatively dense network of tidal creeks and channels draining into the Bidyadhari river which is known in the upper reaches successively as the Haroa river/Nona Gang and Suti Nadi branching out from the Haroa. A large tidal lake is located within TP2 area at the head of a tributary of the Bidyadhari River. The palaeo-tidal mud flats are replete with shallow pans, relic tidal salt marshes/swamps, dry salt pans, sediment filled tidal channels, remnant tidal channel segments still containing water and in-filled tidal creeks with subdued levees. TP2 experiences partial tidal activity.

TP.3 occupies a small area in the southeastern corner of the study area and is characterized by an astonishing network of wide, rectilinear active tidal channels with intervening active mud flats.

Geoarchaeological Synthesis

The detailed geomorphological study around Berachampa and the regional geomorphological study of the surrounding region in 1:50000 and 1:250000 scales, respectively have revealed the linkage between the history of ancient settlements at Berachampa and the development of the fluvial landscape. One hypothesis is discussed in following points.

1. PPM.2 channels could have provided access to the settlement locality of Chandraketugarh.
2. The broad levee (of PPM.2) afforded an excellent settlement site because of the following factors:
   - A. Abundant supply of fresh water from river.
   - B. Possibility of agriculture in the adjoining flood plains characterized by non-saline soil.
   - C. Low threat of cyclones, storm surges and tidal waves, because of the large distance from the sea front.
   - D. Low threat of flood as the PPM.2 meander belt was in the process of drying up.
3. Subsequent to the complete desiccation of PPM.2 channels, the channels of PPM.3 meander belt developed. These channels formed a huge point bar complex in an area just north of Berachampa.
4. Progressive southward migration of the point bar with repeated avulsion of channels gave rise to recurring but low frequency floods.
5. With the stabilization of the point bar, the southward migration of PPM.3 was halted, and recurring floods were reduced in frequency and magnitude. At the same time, the PPM.3 channels of the point bar complex provided an access to the channels of the Bhagirathi and Ichamati meander belts. Subsequent development of a set of parallel, straight PPM.3 channels from the southwestern corner of the point bar, up to the river Bidyadhari provided an access to that river also. Access to these three rivers could have been crucial for communication.
7. A sudden avulsion of a PPM.3 channel, from the southwestern extremity of the major point bar complex (located north of Berachampa) and its subsequent southerly course, close to the eastern end of the settlement, posed a renewed threat of flood.
8. The advantageous location of the settlement could have been disrupted as a result of the following reasons.
   - A. A comparatively new east-west trending belt (Jamuna) emerged from the Bhagirathi in the vicinity of Kalyani, and stretching eastward, joined the meander belt of Ichamati cutting across PPM.1, PPM.2 and PPM.3 meander belts. This meander belt developed when some of the water of Bhagirathi (B.3 stage), flowing in an arcuate meander curve, breached its valley wall (PPM.1) and flowing eastward debouched in the Ichamati (I.2) stage. As a result, water flowing into PPM.3 channels, from the north were diverted along this newly formed meander belt (Jamuna) and the PPM.3 channels flowing close to Berachampa gradually dried up. This phenomenon could have stopped the existing trade network by robbing the region of vital river transport routes to the surrounding areas by denying access to Bhagirathi, Ichamati and Bidyadhari rivers.
   - B. The stoppage of water flow turned the PPM.3 channels around Berachampa, and specially the huge point bar complex to its north, into marshes with stagnant pools of water making it inhospitable for continued settlement.

   The visual interpretation of LANDSAT images and aerial photographs has aided researchers in understanding the evolution of landscape around the archaeological site of Chandraketugarh. A relative chronology of the several palaeo-channels and associated features like levees and the point-bar complex has been devised based on geomorphological methods. The study aids in developing

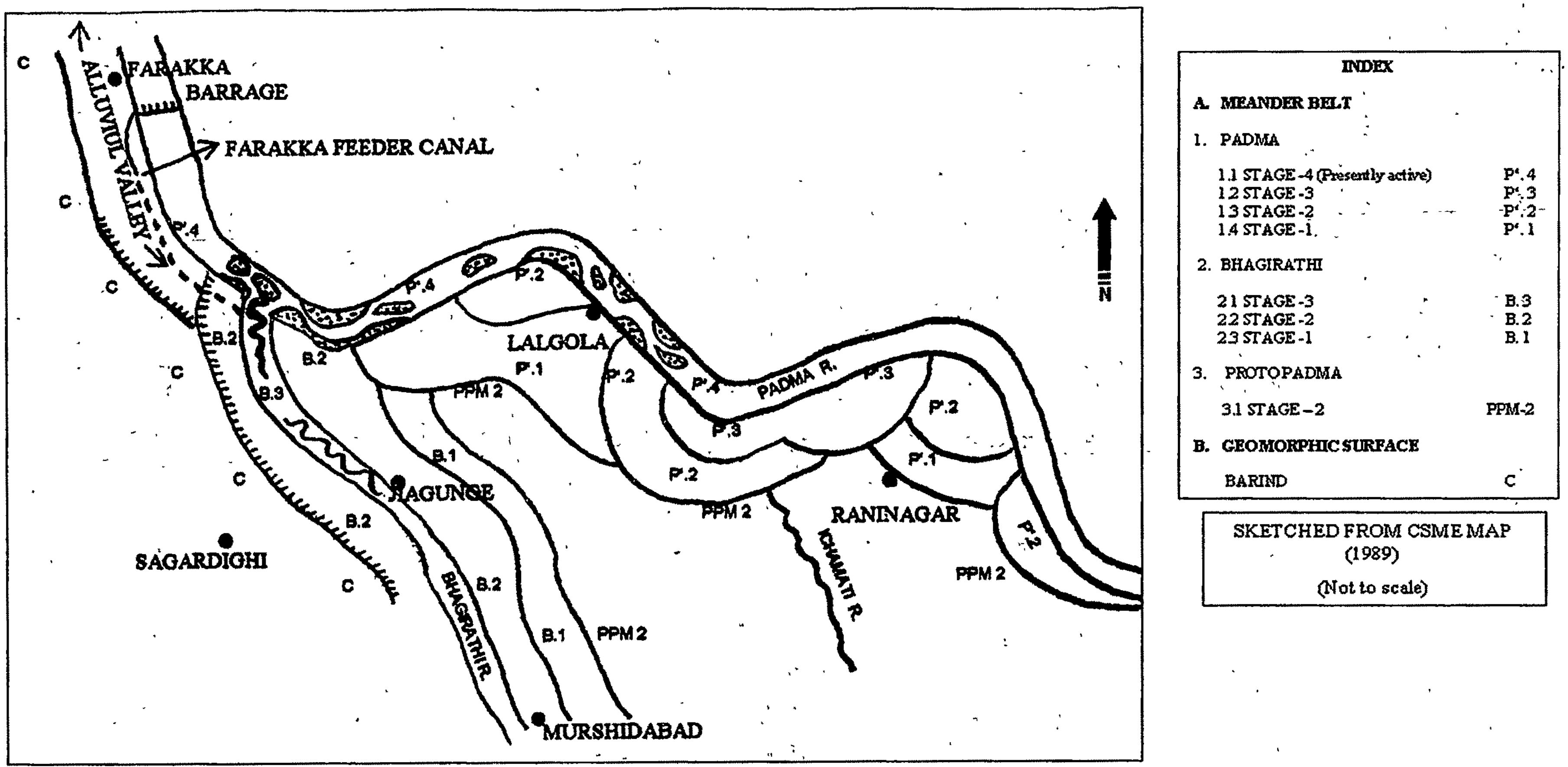


Fig. 7 Schematic sketch map showing course of Padma cutting across Proto-Padma Meander Belt

postulates important for answering the question of why the site of Chandraketugarh was established at that particular location. It is too early to associate cultural processes involved in the development of the site with geomorphological processes. Meaningful research in this direction should be pursued in the future.

Conclusions

A new methodology has been developed for understanding landscape evolution of a part of the upper delta plain of the western part of the composite Ganga-Brahmaputra delta. The methodology involves mapping of meander belts of successive generations of the principal distributaries of the chosen sector of the delta. This was achieved by examining cross-cutting relationships between the belts as well as from contrasts in fluvial plan form. The rise and fall of the Chandraketugarh human settlement was correlated with the relative chronology of successive meander belts. Absolute chronology of the identified meander belts through suitable dating of the respective constituent sediments is required to verify the relative chronology that has been built up by applying this new technique.

Acknowledgements

The present research paper is an outcome of an on-going research project titled 'Mid-Late Holocene Environment and Human Adaptation in the Bengal Basin' funded by the Department of Science and Technology, Government of West Bengal with Dr C. Chakrabarti as the Principal Investigator. We acknowledge kind interactions with Prof S.N. Rajaguru, formerly of Deccan College, Pune at various stages of the investigation and Geological Survey of India (Eastern Region, Salt Lake, Kolkata) for allowing us to consult Air Photographs.

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S.V. Rajesh and A. Patel, *Man and Environment* XXXII(2): 61-136 [2007].
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A Gazetteer of Pre- and Protohistoric Sites in Gujarat

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Background

This gazetteer contains a list of 2247 sites of Pre- and Protohistoric periods of Gujarat. It is based on sites reported in *Indian Archaeology – A Review*, exploration and excavation reports, books, articles in journals, Ph.D. theses and M.A. dissertations. This gazetteer is not free from limitations and faults. Hundreds of sites discovered by various scholars from different parts of Gujarat in recent years are not included as they remain unpublished and we did not have access to all Ph.D. theses and M.A. dissertations. In recent years some new districts have been created in Gujarat by dividing existing districts. Thus, the exact location of most sites remains unknown. In the lists, we have shown sites only in undivided districts.

The distribution of sites does not correctly reflect the original distribution of temporary camps as well as permanent settlements because many sites have either been destroyed by vagaries of nature and human use of the land surface for various activities or are buried in geological deposits. Some areas have been more intensively explored than others and some have not been explored at all and hundreds of sites await discovery. The sites reported in *Indian Archaeology – A Review* suffer from more limitations than those reported in other sources. In many cases the same site has been reported more than once by different explorers or by the same explorer(s), and sometimes the spelling varies even in reports by the same explorer. So one cannot be sure whether the same site or a different site is referred to. In many cases, not only are the geo-coordinates not given, but even details such as distance and direction from the nearest village and name of the district are not provided (Misra 2006). In Gujarat, certain place names are very common, and there are more than one sites of the same name in a district; in such cases, it is almost impossible to locate sites.

In spite of all these drawbacks this gazetteer gives an indication of the broad distribution pattern of Pre- and Protohistoric cultures in Gujarat. In all 2247 sites belong to following cultural periods/stages used in the tables.

Received : 26-5-2007
Revised : 25-8-2007
Accepted : 1-11-2007

S. No.	Period/Culture	No. of Sites
1	Lower Palaeolithic	147
2	Middle Palaeolithic	171
3	Upper Palaeolithic	022
4	Unspecified Palaeolithic	007
5	Mesolithic/Microlithic	719
6	Neolithic	004
7	Pre-Urban Harappan	016
8	Pre-Urban Harappan Burial Pottery	009
9	Anarta Culture/Tradition	069
10	Urban Harappan (Classical/Sorath)	490
11	Post-Urban Harappan	399
12	Lustrous Red Ware (Post-Urban Harappan)	144
13	Unspecified Harappan	050

The sites discussed in this gazetteer are arranged in Tables 1-13 according to culture/period and their distribution is given in Figs. 1-13.

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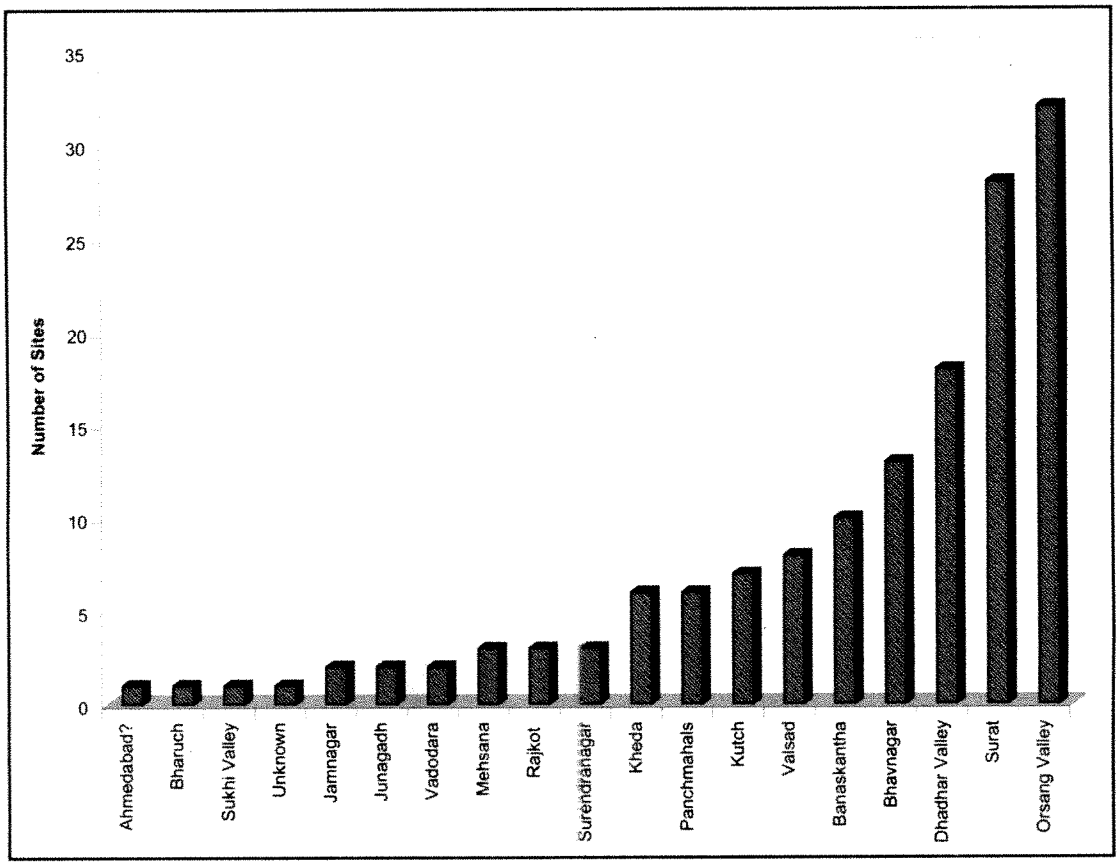

Fig. 1 District/River-wise distribution of Lower Palaeolithic sites in Gujarat

Table 1: Lower Palaeolithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Achali One	Orsang Valley	22° 19' 00" N	73° 08' 00" E	Ajithprasad 1988
2	Aherdi	Surat	-	-	IAR 1967-68
3	Ambapada	Surat	-	-	IAR 1967-68
4	Angia	Kachchh	-	-	IAR 1967-68
5	Atkot	Rajkot	-	-	IAR 1969-70
6	Avadha	Valsad	-	-	IAR 1964-65
7	Babapur	Bhavnagar	-	-	IAR 1979-80
8	Bahadarpur	Orsang Valley	22° 11' 00" N	73° 34' 00" E	Ajithprasad 1988
9	Bapotya	Dhadhar Valley	22° 23' 00" N	73° 37' 00" E	Thomas 1998
10	Bardipada	Surat	-	-	IAR 1967-68
11	Barumal	Valsad	-	-	IAR 1964-65
12	Baskario One	Orsang Valley	22° 18' 50" N	73° 40' 30" E	Ajithprasad 1988
13	Baskario Three	Orsang Valley	22° 18' 50" N	73° 40' 30" E	Ajithprasad 1988
14	Baskario Two	Orsang Valley	22° 18' 50" N	73° 40' 30" E	Ajithprasad 1988
15	Bhajodi	Kachchh	-	-	IAR 1967-68
16	Bhat One	Dhadhar Valley	22° 24' 00" N	73° 40' 00" E	Thomas 1998
17	Bhat Two	Dhadhar Valley	22° 24' 00" N	73° 40' 00" E	Thomas 1998
18	Bhusda	Surat	-	-	IAR 1967-68
19	Borinagaotha	Surat	-	-	IAR 1967-68
20	Borkhal	Surat	-	-	IAR 1967-68
21	Chiklada	Surat	-	-	IAR 1967-68
22	Chuchhapura	Orsang Valley	22° 13' 00" N	73° 36' 00" E	Ajithprasad 1988
23	Datrana Eight	Banaskantha	23° 46' 00" N	71° 06' 45" E	Ajithprasad and Sonawane (in press)
24	Devalia	Bhavnagar	-	-	IAR 1979-80
25	Devisar	Kachchh	-	-	IAR 1967-68
26	Dhadra	Surat	-	-	IAR 1967-68
27	Dharia	Dhadhar Valley	22° 27' 00" N	73° 42' 00" E	Thomas 1998
28	Dharmapuri	Surat	-	-	IAR 1967-68
29	Dholimar Four	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
30	Dholimar One	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
31	Dholimar Three	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
32	Dholimar Two	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
33	Dhranghra	Surendranagar	-	-	IAR 1972-73
34	Dori Dunkar One	Orsang Valley	22° 19' 00" N	73° 42' 20" E	Ajithprasad 1988
35	Dori Dunkar Two	Orsang Valley	22° 19' 00" N	73° 42' 20" E	Ajithprasad 1988
36	Duma Three	Orsang Valley	22° 18' 00" N	73° 41' 20" E	Ajithprasad 1988
37	DumaOne	Orsang Valley	22° 18' 00" N	73° 41' 20" E	Ajithprasad 1988
38	Dungarda	Surat	-	-	IAR 1967-68
39	Galkund	Surat	-	-	IAR 1967-68
40	Galteswar	Kheda	-	-	Momin 1979
41	Ganario-no Thumdo	Banaskantha	23° 56' 10" N	71° 31' 00" E	Ajithprasad and Sonawane (in press)
42	Ghachiya Wado (Santhli Two)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
43	Ghoghadwa	Dhadhar Valley	22° 26' 00" N	73° 39' 00" E	Thomas 1998
44	Gokalpura	Dhadhar Valley	22° 30' 00" N	73° 35' 00" E	Thomas 1998
45	Gokulpura	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
46	Gundiviri One	Orsang Valley	22° 16' 30" N	73° 38' 80" E	Ajithprasad 1988
47	Gundiviri Three	Orsang Valley	22° 16' 30" N	73° 38' 80" E	Ajithprasad 1988
48	Gundiviri Two	Orsang Valley	22° 16' 30" N	73° 38' 80" E	Ajithprasad 1988
49	Hadka Walo Khetar (Datrana Four)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
50	Halvad	Surendranagar	-	-	IAR 1963-64
51	Harhari no Thumdo	Banaskantha	23° 53' 00" N	71° 27' 00" E	Majumdar 1999
52	Harpada	Surat	-	-	IAR 1967-68
53	Haveli One	Orsang Valley	22° 18' 50" N	73° 39' 40" E	Ajithprasad 1988
54	Haveli Two	Orsang Valley	22° 18' 50" N	73° 39' 40" E	Ajithprasad 1988
55	Hiran River	Junagadh	-	-	IAR 1971-72
56	Jamalanapada	Surat	-	-	IAR 1967-68
57	Jhaleria One	Dhadhar Valley	22° 26' 00" N	73° 41' 00" E	Thomas 1998
58	Jhaleria Two	Dhadhar Valley	22° 26' 00" N	73° 41' 00" E	Thomas 1998
59	Jhankharia	Panchmahals	22° 30' 00" N	73° 31' 00" E	Sonawane 1979
60	Jhaverpura	Vadodara	-	-	IAR 1982-83
61	Jogpura	Sukhi Valley	-	-	Ajithprasad 2005
62	Jorwan River	Panchmahal	-	-	IAR 1969-70
63	Kadia Dungar	Baroda	-	-	IAR 1968-69
64	Kakarda	Surat	-	-	IAR 1967-68
65	Kathairyano Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
66	Kevdi	Surat	-	-	IAR 1967-68
67	Khara (Langala)	Bhavnagar	21° 47' 00" N	71° 33' 00" E	Jairath 1986
68	Khari no Timbo (Loteshwar One)	Mehsana	23° 36' 00" N	71° 51' 00" E	Bhan 1994; Majumdar 1999
69	Kolwa	Orsang Valley	22° 16' 70" N	73° 39' 80" E	Ajithprasad 1988
70	Kotamda	Surat	-	-	IAR 1967-68
71	Krakach	Bhavnagar	-	-	IAR 1979-80
72	Lakhiyar Viyaro	Kachchh	-	-	IAR 1970-71
73	Lakhond	Kachchh	-	-	IAR 1967-68
74	Lalpura	Kheda	22° 25' 00" N	73° 10' 00" E	Momin 1979
75	Laphni One	Orsang Valley	22° 19' 00" N	73° 41' 50" E	Ajithprasad 1988
76	Loteshwar	Mehsana	23° 36' 00" N	71° 50' 20" E	Hegde and Sonawane 1986; Bhan 1994
77	Madhwas	Panchmahals	23° 13' 00" N	73° 36' 00" E	Sonawane 1979
78	Mahal	Surat	-	-	IAR 1967-68
79	Mavlipada	Surat	-	-	IAR 1967-68
80	Mohmedpura	Kheda	22° 69' 00" N	73° 19' 00" E	Momin 1979
81	Mohpada	Valsad	-	-	IAR 1964-65
82	Mosabar One	Orsang Valley	22° 13' 00" N	73° 16' 00" E	Ajithprasad 1988
83	MosabarTwo	Orsang Valley	22° 13' 00" N	73° 16' 00" E	Ajithprasad 1988
84	Motacharya	Surat	-	-	IAR 1967-68
85	Mota-Khara (Langala)	Bhavnagar	21° 47' 00" N	71° 33' 00" E	Jairath 1986
86	Motiwalzar	Valsad	-	-	IAR 1968-69
87	Nahara River (Samadhiala)	Bhavnagar	21° 51' 00" N	71° 39' 00" E	Jairath 1986
88	Nakhtarana	Kachchh	-	-	IAR 1967-68
89	Nana Khara (Langala)	Bhavnagar	21° 47' 00" N	71° 33' 00" E	Jairath 1986
90	Nanapada	Surat	-	-	IAR 1967-68
91	Narmada Valley	-	-	-	Possehl 1999
92	Nathakua	Panchmahals	22° 27' 00" N	73° 30' 00" E	Sonawane 1979
93	Nathkua	Dhadhar Valley	22° 26' 00" N	73° 35' 00" E	Thomas 1998
94	Navod no Thumdo (Santhli Four)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
95	Pali	Kheda	22° 49' 00" N	73° 19' 00" E	Momin 1979
96	Pasegam (Charan-no-timbo) (Rajpipla)	Bhavnagar	21° 49' 00" N	71° 35' 00" E	Jairath 1986
97	Pathakwadi	Surat	-	-	IAR 1968-69
98	Pavagadh	Dhadhar Valley	22° 28' 00" N	73° 33' 00" E	Thomas 1998

S.No.	Site Name	District/River	Latitude	Longitude	References
99	Pavagadh	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
100	Pedhami	Ahmedabad?	-	-	Possehl 1999
101	Pindara	Jamnagar	-	-	IAR 1965-66
102	Pipiya Four	Orsang Valley	22° 19' 80" N	73° 43' 60" E	Ajithprasad 1988
103	Pipiya One	Orsang Valley	22° 19' 80" N	73° 43' 60" E	Ajithprasad 1988
104	Pipiya Three	Orsang Valley	22° 19' 80" N	73° 43' 60" E	Ajithprasad 1988
105	Pipiya Two	Orsang Valley	22° 19' 80" N	73° 43' 60" E	Ajithprasad 1988
106	Pratappura	Kheda	22° 29' 00" N	73° 15' 00" E	Momin 1979
107	Rajkot Two	Rajkot	-	-	IAR 1970-71
108	Rajpipla Two	Bhavnagar	21° 53' 00" N	71° 39' 00" E	Jairath 1986
109	Rajpuri	Valsad	-	-	IAR 1964-65
110	Rambhas	Surat	-	-	IAR 1967-68
111	Ratanpura	Orsang Valley	22° 17' 70" N	73° 37' 50" E	Ajithprasad 1988
112	Richbar	Dhadhar Valley	22° 23' 00" N	73° 38' 00" E	Thomas 1998
113	Rojdi	Rajkot	21° 51' 00" N	70° 54' 00" E	Possehl 1999
114	Sagdhra One	Orsang Valley	22° 18' 50" N	73° 37' 30" E	Ajithprasad 1988
115	Sagdhra Three	Orsang Valley	22° 18' 50" N	73° 37' 30" E	Ajithprasad 1988
116	Sagdhra Two	Orsang Valley	22° 18' 50" N	73° 37' 30" E	Ajithprasad 1988
117	Sakarpatal	Surat	-	-	IAR 1967-68
118	Samadhiala	Bhavnagar	-	-	IAR 1970-71
119	Santhli Four	Banaskantha	23° 54' 00" N	71° 28' 50" E	Ajithprasad and Sonawane (in press)
120	Santhli Three	Banaskantha	23° 53' 50" N	71° 29' 00" E	Ajithprasad and Sonawane (in press)
121	Santhli Two	Banaskantha	23° 54' 00" N	71° 29' 10" E	Ajithprasad and Sonawane (in press)
122	Sherdi	Junagadh	-	-	IAR 1963-64
123	Shivrajpur One	Dhadhar Valley	22° 25' 00" N	73° 39' 00" E	Thomas 1998
124	Shivrajpur Three	Dhadhar Valley	22° 25' 00" N	73° 39' 00" E	Thomas 1998
125	Shivrajpur Two	Dhadhar Valley	22° 25' 00" N	73° 39' 00" E	Thomas 1998
126	Shiyali	Bharuch	-	-	IAR 1971-72
127	Sidumbar	Valsad	-	-	IAR 1964-65
128	Singana	Surat	-	-	IAR 1967-68
129	Sukhpur	Surendranagar	-	-	IAR 1967-68
130	Tarpala	Bhavnagar	21° 51' 00" N	71° 45' 00" E	Jairath 1986
131	Timbnigatha	Surat	-	-	IAR 1967-68
132	Travada	Bhavnagar	-	-	IAR 1979-80
133	Uchhakalam	Orsang Valley	22° 16' 30" N	73° 36' 00" E	Ajithprasad 1988
134	Uchhet One	Orsang Valley	22° 18' 00" N	73° 39' 70" E	Ajithprasad 1988
135	Uchhet Three	Orsang Valley	22° 18' 00" N	73° 39' 70" E	Ajithprasad 1988
136	Uchhet Two	Orsang Valley	22° 18' 00" N	73° 39' 70" E	Ajithprasad 1988
137	Upsal	Valsad	-	-	IAR 1968-69
138	Vakharia	Surat	-	-	IAR 1967-68
139	Vasad	Kheda	22° 27' 00" N	73° 04' 00" E	Momin 1979
140	Vatkiwalu Khetar One (Datrana Five)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999
141	Venghdra	Bhavnagar	-	-	IAR 1970-71
142	Veravel	Valsad	-	-	IAR 1964-65
143	Vijaypur	Jamnagar	-	-	Bhan 1989
144	Virani	Kachchh	-	-	IAR 1968-69
145	Wadeli	Orsang Valley	22° 13' 00" N	73° 37' 00" E	Ajithprasad 1988
146	Wai	Surat	-	-	IAR 1967-68
147	Zaran	Surat	-	-	IAR 1967-68

Table 2: Middle Palaeolithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Aditeswara	Bharuch	-	-	IAR 1966-67
2	Aherdi	Surat	-	-	IAR 1967-68
3	Akteshwar	Bharuch	-	-	IAR 1966-67; 1967-68
4	Amba	Bhavnagar	-	-	IAR 1979-80
5	Ambapada	Surat	-	-	IAR 1967-68
6	Anada	Jamnagar	-	-	Bhan 1992
7	Anjar	Kachchh	-	-	IAR 1967-68
8	Babapur	Bhavnagar	-	-	IAR 1979-80
9	Badalpur	Junagadh	20° 53' 00" N	70° 29' 00" E	IAR 1971-72
10	Balitha	Surat	-	-	IAR 1963-64
11	Bamankua	Dhadhar Valley	22° 26' 00" N	73° 39' 00" E	Thomas 1998
12	Bardipada	Surat	-	-	IAR 1967-68
13	Bhadreshwar	Kachchh	-	-	IAR 1970-71
14	Bhamadia	Bharuch	-	-	IAR 1964-65
15	Bharadia	Bharuch	-	-	IAR 1969-70
16	Bhat One	Dhadhar Valley	22° 24' 00" N	73° 40' 00" E	Thomas 1998
17	Bhat Two	Dhadhar Valley	22° 24' 00" N	73° 40' 00" E	Thomas 1998
18	Bhediyapura	Dhadhar Valley	22° 24' 00" N	73° 36' 00" E	Thomas 1998
19	Bhilwara	Surat	-	-	IAR 1971-72
20	Bhimpatal	Ahmedabad	-	-	IAR 1955-56
21	Bhojavadar	Bhavnagar	-	-	IAR 1971-72
22	Bhokhar Dhar (Hadadad)	Bhavnagar	22° 08' 00" N	71° 34' 00" E	Jairath 1986
23	Bhungar	Bhavnagar	-	-	IAR 1979-80
24	Bhusda	Surat	-	-	IAR 1967-68
25	Bilwada/Bilwara	Bharuch	-	-	IAR 1968-69
26	Boradi	Bhavnagar	-	-	IAR 1979-80
27	Borinagaotha	Surat	-	-	IAR 1967-68
28	Borkhal	Surat	-	-	IAR 1967-68
29	Butona ni-Dhar (Thalsar)	Bhavnagar	21° 32' 00" N	71° 10' 00" E	Jairath 1986
30	Cha	Bhavnagar	-	-	IAR 1979-80
31	Chakalia	Panchmahals	23° 03' 00" N	74° 18' 00" E	Sonawane 1979
32	Chakiaro	Panchmahal	-	-	Ghosh 1989
33	Chamol	Bhavnagar	-	-	IAR 1979-80
34	Champaner	Dhadhar Valley	22° 29' 00" N	73° 34' 00" E	Thomas 1998
35	Charania no Timbo (Samadhiala)	Bhavnagar	21° 52' 00" N	71° 41' 00" E	Jairath 1986
36	Chattawada	Bharuch	-	-	IAR 1969-70
37	Chiklada	Surat	-	-	IAR 1967-68
38	Chikli	Bharuch	-	-	IAR 1969-70
39	Dadra/Dabra	Bharuch	-	-	IAR 1970-71
40	Damrala	Bhavnagar	-	-	IAR 1979-80
41	Deta	Kachchh	-	-	IAR 1967-68
42	Devalia	Bhavnagar	-	-	IAR 1979-80
43	Dhadra	Surat	-	-	IAR 1967-68
44	Dharmapuri	Surat	-	-	IAR 1967-68
45	Dholimar Four	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
46	Dholimar One	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
47	Dholimar Three	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
48	Dholimar Two	Dhadhar Valley	22° 26' 00" N	73° 40' 00" E	Thomas 1998
49	Dhoraji	Surendranagar	-	-	IAR 1967-68
50	Dhranghra	Surendranagar	-	-	IAR 1972-73

S.No.	Site Name	District/River	Latitude	Longitude	References
51	Dungarda	Surat	-	-	IAR 1967-68
52	Galkund	Surat	-	-	IAR 1967-68
53	Ghata	Bharuch	-	-	IAR 1961-62
54	Ghoghadwa	Dhadhar Valley	22° 26' 00" N	73° 39' 00" E	Thomas 1998
55	Ghograla-no-timbo (Prahladgadh)	Bhavnagar	-	-	Jairath 1986
56	Gokalpura	Dhadhar Valley	22° 30' 00" N	73° 35' 00" E	Thomas 1998
57	Gokulpura	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
58	Gundia	Bharuch	-	-	IAR 1969-70
59	Halvad	Surendranagar	-	-	IAR 1963-64
60	Harpada	Surat	-	-	IAR 1967-68
61	Handi	Bharuch	-	-	IAR 1969-70
62	Jabugam	Bharuch	-	-	IAR 1964-65
63	Jamalanapada	Surat	-	-	IAR 1967-68
64	Jamnia	Bharuch	-	-	IAR 1969-70
65	Jhaleria Two	Dhadhar Valley	22° 26' 00" N	73° 41' 00" E	Thomas 1998
66	Jhankharia	Panchmahals	22° 30' 00" N	73° 31' 00" E	Sonawane 1979
67	Jogpura	Sukhi Valley	-	-	Ajithprasad 2005
68	Jitgadh	Bharuch	-	-	IAR 1969-70
69	Jitgadh	Bhavnagar	-	-	IAR 1969-70
70	Jorwan River	Panchmahal	-	-	IAR 1969-70
71	Junagadh (Adi Chadi no Van)	Junagadh	-	-	IAR 1956-57
72	Kakarda	Surat	-	-	IAR 1967-68
73	Kalavad One	Jamnagar	-	-	Bhan 1994
74	Kalubhar River (Samadhiala)	Bhavnagar	21° 51' 00" N	71° 51' 00" E	Jairath 1986
75	Kamlol Nava	Bhavnagar	-	-	IAR 1979-80
76	Kankawati	Junagadh	-	-	IAR 1963-64
77	Kankot	Bhavnagar	-	-	IAR 1979-80
78	Katkua	Dhadhar Valley	22° 23' 00" N	73° 40' 00" E	Thomas 1998
79	Katoda	Kachchh	-	-	IAR 1967-68
80	Kesarava	Bharuch	-	-	IAR 1968-69
81	Kevdi	Surat	-	-	IAR 1967-68
82	Khaparia	Valsad	-	-	IAR 1969-70
83	Khara Pat (Bhojavadar)	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
84	Kharera	Surat	-	-	IAR 1971-72
85	Khojalwasa	Bharuch	-	-	IAR 1969-70
86	Khotawadi Timbo (Bhojavadar)	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
87	Kotamda	Surat	-	-	IAR 1967-68
88	Krakach	Bhavnagar	-	-	IAR 1979-80
89	Kurel	Valsad	-	-	IAR 1968-69
90	Lakhiyar Viyaro	Kachchh	-	-	IAR 1970-71
91	Lakhond	Kachchh	-	-	IAR 1967-68
92	Lavacha	Surat	-	-	IAR 1963-64
93	Madhwas	Panchmahals	23° 13' 00" N	73° 36' 00" E	Sonawane 1979
94	Mahal	Surat	-	-	IAR 1967-68
95	Malotha	Valsad	-	-	IAR 1969-70
96	Mathal	Kachchh	-	-	IAR 1967-68
97	Mavlipada	Surat	-	-	IAR 1967-68
98	Mekada	Bhavnagar	-	-	IAR 1979-80
99	Mirkot	Surat	-	-	IAR 1969-70
100	Motacharya	Surat	-	-	IAR 1967-68

S.No.	Site Name	District/River	Latitude	Longitude	References
101	Moti Paneli	Rajkot	-	-	IAR 1958-59
102	Moti Ranbhet	Dhadhar Valley	22° 22' 00" N	73° 37' 00" E	Thomas 1998
103	Motiwalzar	Valsad	-	-	IAR 1968-69
104	Movi	Bharuch	-	-	IAR 1969-70
105	Nadisar	Panchmahals	22° 53' 00" N	73° 24' 00" E	Sonawane 1979
106	Namdha	Surat	-	-	IAR 1963-64
107	Nanapada	Surat	-	-	IAR 1967-68
108	Nani Nikole	Bharuch	-	-	IAR 1971-72
109	Narmada Valley	-	-	-	Possehl 1999
110	Narukot	Dhadhar Valley	22° 24' 00" N	73° 44' 00" E	Thomas 1998
111	Narvania	Dhadhar Valley	22° 26' 00" N	73° 42' 00" E	Thomas 1998
112	Navagam	Bharuch	-	-	IAR 1969-70
113	Nesdi (Valabhipur)	Bhavnagar	21° 53' 00" N	71° 55' 00" E	Jairath 1986
114	Nichadi	Bhavnagar	-	-	IAR 1979-80
115	Padam Tekri/ Dungari	Valsad	-	-	IAR 1965-66
116	Pakhra Dungar	Kachchh	-	-	IAR 1967-68
117	Palanpur	Dhadhar Valley	22° 25' 00" N	73° 37' 00" E	Thomas 1998
118	Patal	Bharuch	-	-	IAR 1969-70
119	Pavagadh	Dhadhar Valley	22° 28' 00" N	73° 33' 00" E	Thomas 1998
120	Pavagadh	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
121	Petia	Bharuch	-	-	IAR 1969-70
122	Pitavadi	Bhavnagar	-	-	IAR 1979-80
123	Pitvajal	Bhavnagar	-	-	IAR 1979-80
124	Raipara	Bharuch	-	-	IAR 1969-70
125	Rajalwada	Bharuch	-	-	IAR 1968-69
126	Rajpipla Two	Bhavnagar	21° 53' 00" N	71° 39' 00" E	Jairath 1986
127	Rajthali	Bhavnagar	-	-	IAR 1979-80
128	Rambhas	Surat	-	-	IAR 1967-68
129	Ranifalia	Valsad	-	-	IAR 1968-69
130	Ranipura	Bharuch	-	-	IAR 1970-71
131	Rasnalia-no-timbo (Patana)	Bhavnagar	21° 47' 00" N	71° 32' 00" E	Jairath 1986
132	Ratadia	Kachchh	-	-	IAR 1963-64
133	Rojdi	Rajkot	21° 51' 00" N	70° 54' 00" E	Possehl 1999
134	Rugnathparu	Bhavnagar	-	-	IAR 1979-80
135	Rupavati	Bhavnagar	-	-	IAR 1979-80
136	Sakarpatal	Surat	-	-	IAR 1967-68
137	Samadhi Timbo (Samadhiala)	Bhavnagar	21° 52' 00" N	71° 41' 00" E	Jairath 1986
138	Samadhiala	Bhavnagar	-	-	IAR 1970-71
139	Sambaria	Bharuch	-	-	IAR 1969-70
140	Samdhi	Orsang Valley	22° 16' 70" N	73° 39' 50" E	Ajithprasad 1988
141	Sangana Nava	Bhavnagar	-	-	IAR 1979-80
142	Sarangapur	Bhavnagar	-	-	IAR 1979-80
143	Selot	Bharuch	-	-	IAR 1968-69
144	Shedravadar	Bhavnagar	-	-	IAR 1979-80
145	Shivrajpur Two	Dhadhar Valley	22° 25' 00" N	73° 39' 00" E	Thomas 1998
146	Shiyali	Bharuch	-	-	IAR 1971-72
147	Sindhai	Valsad	-	-	IAR 1969-70
148	Singana	Surat	-	-	IAR 1967-68
149	Talia	Bhavnagar	-	-	IAR 1979-80
150	Tarana One	Jamnagar	-	-	Bhan 1992
151	Tarpala	Bhavnagar	21° 51' 00" N	71° 45' 00" E	Jairath 1986
152	Thoriali	Surendranagar	-	-	IAR 1961-62
153	Timbnigatha	Surat	-	-	IAR 1967-68

S.No.	Site Name	District/River	Latitude	Longitude	References
154	Travada	Bhavnagar	-	-	IAR 1979-80
155	Tukwada	Surat	-	-	IAR 1963-64
156	Uka Dam	Surat	-	-	IAR 1969-70
157	Uman	Bharuch	-	-	IAR 1970-71
158	Umrala	Bhavnagar	21° 51' 00" N	71° 51' 00" E	Jairath 1986
159	Upsal	Valsad	-	-	IAR 1968-69
160	Vadakhunta	Bharuch	-	-	IAR 1968-69
161	Vaidwali Mohra	Kachchh	-	-	IAR 1985-86
162	Vakharia	Surat	-	-	IAR 1967-68
163	Vangadhra	Bhavnagar	21° 51' 00" N	71° 41' 00" E	Jairath 1986
164	Vangadhra Tarpala	Bhavnagar	-	-	Jairath 1986
165	Vankia	Bhavnagar	-	-	IAR 1979-80
166	Velavadar	Bhavnagar	-	-	IAR 1979-80
167	Vinjllan	Kachchh	-	-	IAR 1967-68
168	Wai	Surat	-	-	IAR 1967-68
169	Wankaria	Dhadhar Valley	22° 26' 00" N	73° 36' 00" E	Thomas 1998
170	Yaksha	Kachchh	-	-	IAR 1967-68
171	Zaran	Surat	-	-	IAR 1967-68

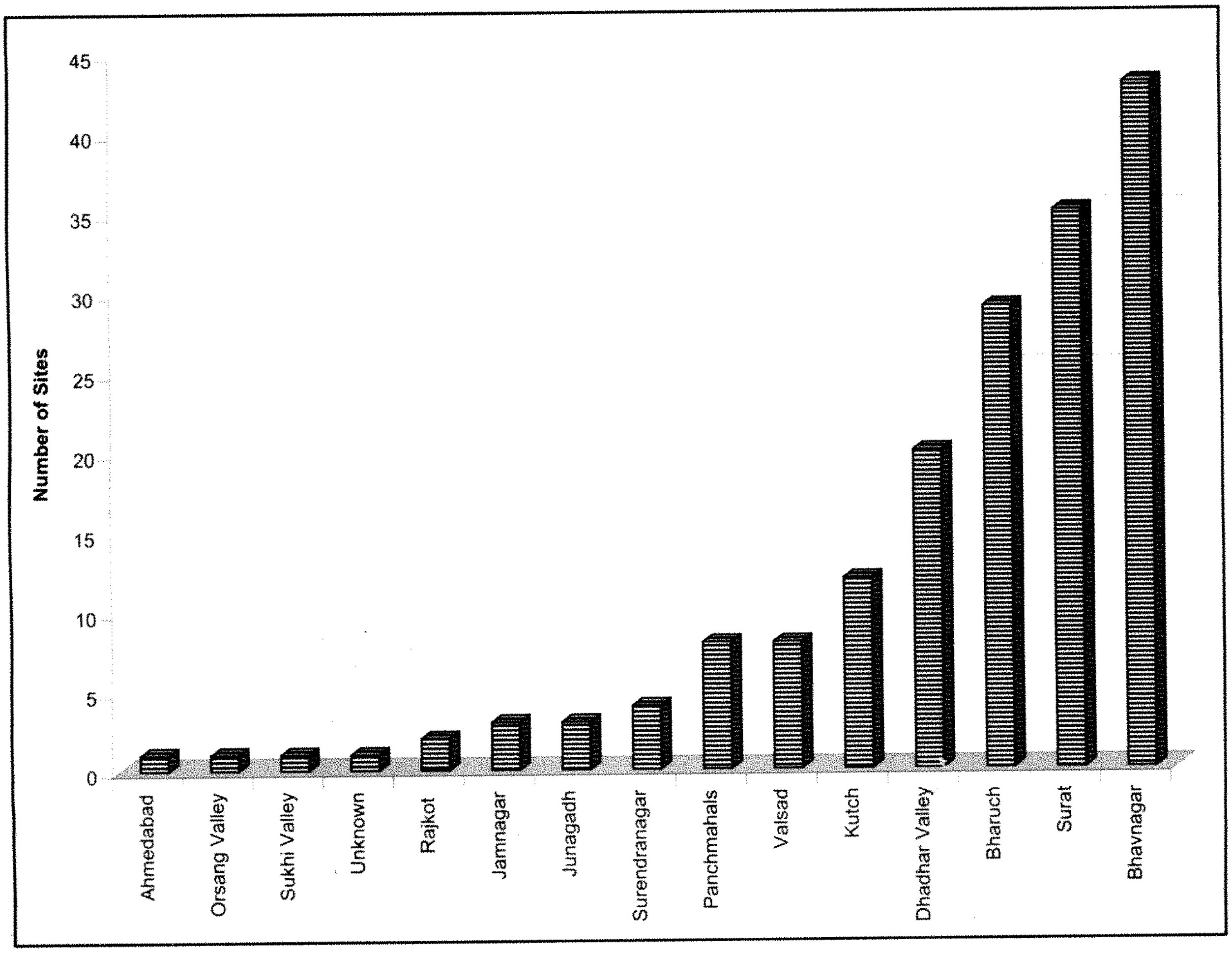

Fig. 2 District/River-wise distribution of Middle Palaeolithic sites in Gujarat

Table 3: Upper Palaeolithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Akteshwar	Bharuch	-	-	IAR 1966-67; 1967-68
2	Bamankua	Dhadhar Valley	22° 26' 00" N	73° 39' 00" E	Thomas 1998
3	Bhamaria	Dhadhar Valley	22° 24' 00" N	73° 36' 00" E	Thomas 1998
4	Bhojade	Ahmedabad	-	-	IAR 1982-83
5	Chelawada	Dhadhar Valley	22° 29' 00" N	73° 34' 00" E	Thomas 1998
6	Chikli	Bharuch	-	-	IAR 1969-70
7	Dharia	Dhadhar Valley	22° 27' 00" N	73° 42' 00" E	Thomas 1998
8	Jaban One	Dhadhar Valley	22° 24' 00" N	73° 41' 00" E	Thomas 1998
9	Jaban Three	Dhadhar Valley	22° 24' 00" N	73° 41' 00" E	Thomas 1998
10	Jaban Two	Dhadhar Valley	22° 24' 00" N	73° 41' 00" E	Thomas 1998
11	Kantali	Dhadhar Valley	22° 25' 00" N	73° 36' 00" E	Thomas 1998
12	Kherap	Dhadhar Valley	22° 28' 00" N	73° 37' 00" E	Thomas 1998
13	Palanpur	Dhadhar Valley	22° 25' 00" N	73° 37' 00" E	Thomas 1998
14	Pavagadh	Dhadhar Valley	22° 28' 00" N	73° 33' 00" E	Thomas 1998
15	Pavagadh	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
16	Pol	Dhadhar Valley	22° 27' 00" N	73° 39' 00" E	Thomas 1998
17	Talawadi One	Dhadhar Valley	22° 27' 00" N	73° 40' 00" E	Thomas 1998
18	Talawadi Two	Dhadhar Valley	22° 27' 00" N	73° 40' 00" E	Thomas 1998
19	Uchhakalam	Orsang Valley	22° 16' 30" N	73° 36' 00" E	Ajithprasad 1988
20	Vavri	Dhadhar Valley	22° 27' 00" N	73° 38' 00" E	Thomas 1998
21	Visadi	Ahmedabad	-	-	IAR 1970-71
22	Visadi	Panchmahals	22° 14' 00" N	73° 43' 00" E	Sonawane 1979

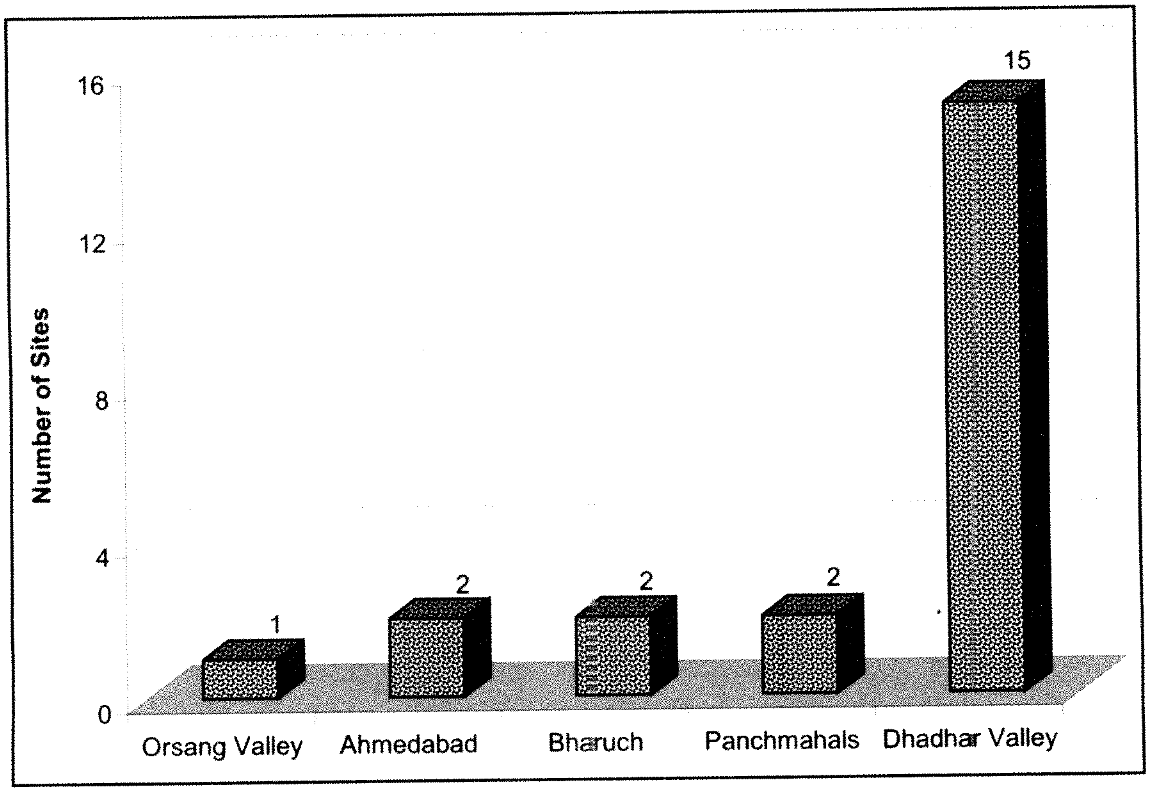

Fig. 3 District/River-wise distribution of Upper Palaeolithic sites in Gujarat

Table 4: Palaeolithic sites of unspecified stages in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Bhavali	Surat	-	-	IAR 1987-88
2	Bheskatri	Surat	-	-	IAR 1989-90
3	Medha	Surat	-	-	IAR 1988-89
4	Modasa	Sabarkantha	-	-	IAR 1958-59
5	Mogawa	Surat	-	-	IAR 1988-89
6	Sevati	Surat	-	-	IAR 1988-89
7	Tavali	Surat	-	-	IAR 1988-89

Table 5: Mesolithic/Microlithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Aakodia	Kachchh	-	-	IAR 1967-68
2	Achali One	Orsang Valley	22° 19' 00" N	73° 08' 00" E	Ajithprasad 1988
3	Achali Three	Orsang Valley	22° 19' 00" N	73° 38' 00" E	Ajithprasad 1988
4	Achali Two	Orsang Valley	22° 19' 00" N	73° 38' 00" E	Ajithprasad 1988
5	Achhala	Panchmahals	22° 40' 00" N	73° 38' 00" E	IAR 1972-73; Sonawane 1979
6	Adadra	Panchmahals	22° 35' 00" N	73° 33' 00" E	IAR 1972-73; Sonawane 1979
7	Adeva	Kheda	-	-	Momin 1979
8	Adhevada	Bhavnagar	-	-	Patel 1992
9	Aditeswara	Bharuch	-	-	IAR 1966-67
10	Aherdi	Surat	-	-	IAR 1967-68
11	Ajivino Timbo	Mehsana	23° 37' 00" N	71° 47' 50" N	Bhan 1994
12	Akhaj	Mehsana	-	-	Patel 1992
13	Akkadia Mota	Amreli	-	-	Possehl 1999

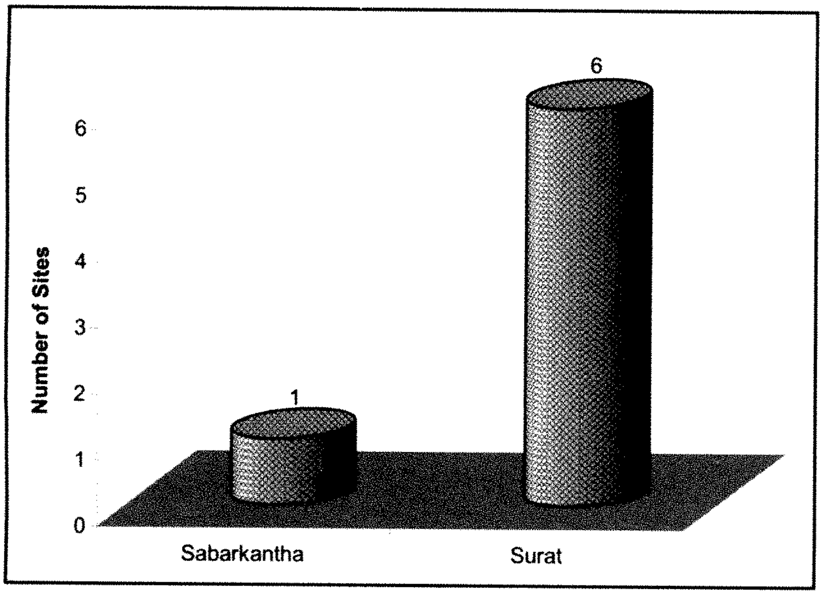

Fig. 4 District-wise distribution of unspecified Palaeolithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
14	Akota/Vadodara	Vadodara	22° 17' 00" N	73° 35' 00" E	Subbarao 1953
15	Akteshwar	Bharuch	-	-	IAR 1966-67; 1967-68
16	Akvada	Bhavnagar	-	-	IAR 1980-81
17	Amachak (Purna Valley)	Surat	-	-	IAR 1968-69
18	Amaroli (Purna Valley)	Surat	-	-	IAR 1968-69
19	Amba	Bhavnagar	-	-	IAR 1979-80
20	Ambakut	Vadodara	22° 49' 00" N	73° 52' 00" E	Sonawane 2002; Devi 2003
21	Ambaliara	Kheda	-	-	Patel 1992
22	Ambapada	Surat	-	-	IAR 1967-68
23	Ambia	Surat	-	-	IAR 1989-90
24	Amirgadh	Banaskantha	-	-	Parikh 1977
25	Amra	Jamnagar	22° 16' 00" N	69° 56' 00" E	Rao 1963; Joshi *et al.* 1984; Bhan 1986
26	Amranghna Muvada	Ahmedabad	-	-	Patel 1992
27	Amrapura	Vadodara	-	-	Mehta 1957
28	Anada	Jamnagar	-	-	Patel 1992
29	Anandpur	Ahmedabad	-	-	Patel 1992
30	Anas/Annas	Panchmahals	22° 22' 00" N	74° 26' 00" E	Sonawane 1979
31	Andhatri	Surat	-	-	Patel 1992
32	Angadh	Vadodara	-	-	Mehta 1957
33	Anger	Kachchh	-	-	Patel 1992
32	Angadh	Vadodara	-	-	Mehta 1957
33	Anger	Kachchh	-	-	Patel 1992
34	Anguria	Banaskantha	-	-	IAR 1963-64
35	Anguthala	Ahmedabad	-	-	Patel 1992
36	Anjar	Kachchh	-	-	IAR 1967-68
37	Ankodia	Kachchh	-	-	Patel 1992
38	Arikhan One	Jamnagar	22° 05' 00" N	70° 01' 00" E	Patel 1992
39	Arteshwar	Bharuch	-	-	Mehta 1957
40	Auguria	Banaskantha	-	-	Patel 1992
41	Aval Javal	Ahmedabad	-	-	IAR 1971-72
42	Babapur	Bhavnagar	-	-	IAR 1979-80
43	Babarkot	Bhavnagar	22° 16' 04" N	71° 34' 15" E	IAR 1955-56; Rao 1963; Possehl 1980; 1999
44	Babra	Ahmedabad	-	-	Patel 1992
45	Badodara	Ahmedabad	22° 45' 00" N	72° 14' 00" E	Mirchandai 1981
46	Bagasara (Gola Dhoro)	Rajkot	22° 50' 00" N	70° 41' 00" E	Sonawane *et al.* 2003; Bhan *et al.* 2005
47	Bagayano Timbo	Mehsana	23° 25' 00" N	71° 48' 00" N	Hegde and Sonawane 1986; Bhan 1994
48	Bahiyal	Ahmedabad	-	-	Patel 1992
49	Bajaniya no Thumdo (Koliwada Three)	Banaskantha	23° 51' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press); Majumdar 1999
50	Bakor	Panchmahals	23° 21' 00" N	73° 35' 00" E	Sonawane 1979
51	Bakrol	Ahmedabad	22° 66' 00" N	72° 44' 00" E	Mirchandani 1981
52	Balamdi	Jamnagar	22° 12' 00" N	70° 22' 00" E	Patel 1992
53	Balanamuvada	Vadodara	-	-	Mehta 1957
54	Balasinor	Kheda	22° 57' 00" N	73° 20' 00" E	Momin 1979
55	Balbhai no Timbo	Mehsana	23° 27' 00" N	71° 46' 00" E	Majumdar 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
56	Baleshi	Surat	-	-	IAR 1982-83
57	Baleshwar	Bharuch	-	-	Patel 1992
58	Baleth	Surat	-	-	Patel 1992
59	Baludra	Banaskantha	-	-	Patel 1992
60	Barala	Banaskantha	-	-	IAR 1964-65
61	Bardipada	Surat	-	-	IAR 1967-68
62	Bardoli	Ahmedabad	-	-	Patel 1992
63	Baria	Ahmedabad	-	-	Patel 1992
64	Bavaka	Panchmahal	-	-	Sonawane 1979
65	Bedvan Moti	Bharuch	-	-	IAR 1969-70
66	Bekharia	Bharuch	-	-	IAR 1969-70
67	Beleshwar	Bharuch	-	-	IAR 1971-72
68	Beludra	Banaskantha	-	-	Parikh 1977
69	Beran	Junagadh	-	-	IAR 1954-55
70	Besunia	Surat	-	-	IAR 1989-90
71	Bet Dwaraka	Jamnagar	22° 20' 00" N	69° 05' 00" E	IAR 1969-70; Joshi *et al.* 1984; Bhan 1986
72	Bhadi	Bhavnagar	-	-	Jairath 1986
73	Bhadrod	Panchmahals	23° 18' 00" N	73° 39' 00" E	Sonawane 1979
74	Bhagatrav	Bharuch	21° 29' 00" N	72° 42' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; Joshi *et al.* 1984
75	Bhagwanpura	Orsang Valley	22° 16' 50" N	73° 35' 50" E	Ajithprasad 1988
76	Bhaikotalia	Panchmahal	-	-	IAR 1972-73
77	Bhamadia	Bharuch	-	-	Mehta 1957
78	Bhamaria	Panchmahals	22° 25' 00" N	73° 30' 00" E	Sonawane 1979
79	Bhamaria	Dhadhar Valley	22° 24' 00" N	73° 36' 00" E	Thomas 1998
80	Bhamnamah	Surat	-	-	IAR 1989-90
81	Bhangsimala	Panchmahal	-	-	IAR 1970-71
82	Bhanvad	Jamnagar	-	-	Bhan 1983
83	Bharadia	Bharuch	-	-	IAR 1969-70
84	Bhatapura/Bhatpur	Ahmedabad	22° 51' 00" N	72° 41' 00" E	IAR 1971-72; Mirchandani 1981; Patel 1992
85	Bhatti-no Timbo (Bhadravadi)	Bhavnagar	22° 12' 00" N	71° 34' 00" E	Jairath 1986
86	Bhavada	Ahmedabad	22° 46' 00" N	72° 47' 00" E	Mirchandani 1981
87	Bhavali	Surat	-	-	IAR 1987-88
88	Bhayani	Ahmedabad	22° 25' 00" N	72° 14' 00" E	Mirchandani 1981
89	Bheskatri	Surat	-	-	IAR 1989-90
90	Bhilwara	Surat	-	-	IAR 1971-72
91	Bhimdad	Bhavnagar	22° 05' 00" N	71° 34' 00" E	Jairath 1986
92	Bhojavadar	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
93	Bhokhardhar (Hadadad)	Bhavnagar	22° 08' 00" N	71° 34' 00" E	Jairath 1986
94	Bhukhi	Panchmahal	-	-	IAR 1972-73
95	Bhungar	Bhavnagar	-	-	IAR 1979-80
96	Bhusda	Surat	-	-	IAR 1967-68
97	Bhutaria	Kachchh	-	-	Patel 1992
98	Bhuval/Bhuvel/Bhuwal	Ahmedabad	-	-	IAR 1970-71; Patel 1992
99	Bibipur	Ahmedabad	22° 55' 00" N	72° 14' 00" E	Mirchandani 1981
100	Bilwada/Bilwara	Bharuch	-	-	IAR 1968-69

S.No.	Site Name	District/River	Latitude	Longitude	References
101	Bodha/Bobha	Kheda	-	-	Momin 1979; Patel 1992
102	Bokhira	Porbandar	21° 39' 20" N	69° 36' 10" E	Gaur *et al.* 2006
103	Boradi	Bhavnagar	-	-	IAR 1979-80
104	Borinagaotha	Surat	-	-	IAR 1967-68
105	Borkhadi	Surat	-	-	IAR 1968-69
106	Borkhal	Surat	-	-	IAR 1967-68
107	Borkhas	Surat	-	-	IAR 1986-87
108	Buhari	Surat	-	-	Patel 1992
109	Bunari (Purna Valley)	Surat	-	-	IAR 1968-69
110	Buteda	Bharuch	-	-	Mehta 1957
111	Cha	Bhavnagar	-	-	IAR 1979-80
112	Chak	Ahmedabad	-	-	Patel 1992
113	Chakalia	Panchmahals	23° 03' 00" N	74° 18' 00" E	Sonawane 1979
114	Chamol	Bhavnagar	-	-	IAR 1979-80
115	Chandod	Vadodara	-	-	Mehta 1957
116	Changda	Kheda	22° 32' 00" N	72° 33' 00" E	IAR 1972-73; 1974-75; Momin 1979
117	Chankalia	Panchmahals	-	-	Sonawane 1979
118	Chattawada	Bharuch	-	-	IAR 1969-70
119	Chavadia/ Chavodia	Panchmahals	23° 05' 00" N	73° 38' 00" E	IAR 1972-73; Sonawane 1979
120	Chavlaj	Ahmedabad	22° 56' 00" N	72° 47' 00" E	Mirchandani 1981
121	Chelawada	Dhadhar Valley	22° 29' 00" N	73° 34' 00" E	Thomas 1998
122	Chikli	Bharuch	-	-	IAR 1969-70
123	Chipur	Surat	-	-	IAR 1986-87
124	Chundadi	Panchmahal	-	-	IAR 1971-72
125	Chunkalia	Panchmahal	-	-	IAR 1971-72
126	Churawadi	Surat	-	-	IAR 1986-87
127	Cycle Factory Site (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
128	Dabhela	Banaskantha	-	-	Patel 1992
129	Dabheri	Bharuch	-	-	IAR 1969-70
130	Dabhoi	Vadodara	-	-	Mehta 1957
131	Dadaria (Purna Valley)	Surat	-	-	IAR 1968-69
132	Dadra/Dabra	Bharuch	-	-	IAR 1970-71
133	Damatvan	Ahmedabad	22° 53' 00" N	72° 43' 00" E	Mirchandani 1981
134	Damnagar	Amreli	-	-	IAR 1969-70
135	Damrala	Bhavnagar	-	-	IAR 1979-80
136	Dangarva	Ahmedabad	23° 28' 00" N	72° 15' 00" E	Patel 1992
137	Dasalwada	Kheda	22° 59' 00" N	73° 09' 00" E	Momin 1979
138	Datrana	Banaskantha	23° 41' 00" N	71° 08' 00" E	Ajithprasad and Sonawane (in press)
139	Datrana Eight	Banaskantha	23° 46' 00" N	71° 06' 45" E	Ajithprasad and Sonawane (in press)
140	Deesa	Banaskantha	-	-	Patel 1992
141	Dehada	Kheda	22° 23' 00" N	72° 33' 00" E	Momin 1979; Momin 1984
142	Delvada	Sabarkantha	-	-	IAR 1969-70
143	Dentali	Mehsana	-	-	Patel 1992
144	Desalpur	Kachchh	23° 25' 00" N	60° 10' 00" E	Joshi 1972
145	Dessar	Vadodara	-	-	Mehta 1957

S.No.	Site Name	District/River	Latitude	Longitude	References
146	Devalia	Bhavnagar	-	-	IAR 1979-80
147	Devaliyo	Amreli	21° 52' 00" N	71^{c} 25' 00" E	IAR 1955-56; Ghosh 1989
148	Devdi	Ahmedabad	22° 55' 00" N	72° 39' 00" E	Mirchandani 1981
149	Devnimori (Dhenk Wadlo)	Sabarkantha	-	-	Mehta *et al.* 1966
150	Dhadra	Surat	-	-	IAR 1967-68
151	Dhahela	Banaskantha	-	-	Parikh 1977
152	Dhajamba	Surat	-	-	IAR 1986-87
153	Dhakadino Timbo	Mehsana	23° 16' 00" N	71° 48' 00" N	Bhan 1994
154	Dhakhan Kunda no Timbo	Bhavnagar	22° 09' 00" N	71° 35' 00" E	Jairath 1986
155	Dhamatwan	Ahmedabad	-	-	IAR 1968-69
156	Dhaneti	Kachchh	-	-	IAR 1970-71
157	Dhansura	Sabarkantha	23° 20' 00" N	73° 15' 00" E	Pandya *et al.* 1990
158	Dharampur	Jamnagar	23° 07' 00" N	69° 54' 00" E	Patel 1992
159	Dharia	Dhadhar Valley	22° 27' 00" N	73° 42' 00" E	Thomas 1998
160	Dharisana	Ahmedabad	-	-	Patel 1992
161	Dharmapuri	Surat	-	-	IAR 1967-68
162	Dharmpur	Jamnagar	-	-	Bhan 1997
163	Dharvania	Mehsana	-	-	Patel 1992
164	Dhatva	Surat	21° 09' 00" N	72° 46' 00" E	Mehta *et al.*1975; Bhan 1989
165	Dholavira	Kachchh	23° 53' 10" N	70° 13' 00" E	Joshi *et al.* 1984; Bisht 1989a; 1989b; 1991; 1994; 2004
166	Dholka	Surat	-	-	IAR 1989-90
167	Diwada Colony/Diwada	Panchmahals	23° 17' 00" N	73° 43' 00" E	Sonawane 1979
168	Dodaka	Vadodara	-	-	Mehta 1957
169	Dohada	Kheda	-	-	IAR 1971-72
170	Dolapura	Vadodara	-	-	IAR 1983-84
171	Dosodoshino Timbo	Mehsana	23° 31' 00" N	71° 47' 00" N	Bhan 1994
172	Dubhakia Mound (Chamardi)	Bhavnagar	21° 05' 00" N	71° 53' 00" E	Jairath 1986
173	Duderiya Timbo	Mehsana	23° 25' 00" N	71° 48' 00" N	Bhan 1994
174	Duma Two	Orsang Valley	22° 18' 00" N	73° 41' 00" E	Ajithprasad 1988
175	Dumad	Vadodara	22° 18' 00" N	73° 41' 00" E	Mehta 1957
176	Dungarda	Surat	-	-	IAR 1967-68
177	Dungripura	Vadodara	-	-	Mehta 1957
178	Ervada	Surendranagar	-	-	Patel 1992
179	Fatehpur	Sabarkantha	-	-	Patel 1992
180	Fulji nu Muwada	Kheda	-	-	Momin 1979
181	Gadh	Kachchh	-	-	IAR 1967-68
182	Gadhachadi	Panchmahals	22° 47' 00" N	73° 39' 00" E	Sonawane 1979
183	Gadhali	Bhavnagar	21° 52' 00" N	71° 36' 00" E	Jairath 1986
184	Gadher	Bharuch	-	-	IAR 1988-89
185	Galil	Kheda	-	-	IAR 1971-72
186	Galkund	Surat	-	-	IAR 1967-68
187	Gamania Ni Timbi Two	Kachchh	-	-	IAR 1967-68
188	Gamnia ni Timbi One	Kachchh	-	-	Patel 1992
189	Ganajadia no Timbo (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
190	Ganario-no Thumdo	Banaskantha	23° 56' 10" N	71° 31' 00" E	Ajithprasad and Sonawane (in press)
191	Gandobhai no Timbo	Ahmedabad	22° 15' 54" N	71° 53' 14" E	Dimri 1999
192	Gansidu	Vadodara	-	-	Patel 1992

S.No.	Site Name	District/River	Latitude	Longitude	References
193	Garudeshwar	Bharuch	-	-	Mehta 1957
194	Garwan	Surat	-	-	IAR 1989-90
195	Ghachiya Wado (Santhli Two)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
196	Ghadhara	Mehsana	-	-	Patel 1992
197	Ghaga River	Broach	-	-	IAR 1967-68
198	Ghata	Bharuch	-	-	IAR 1961-62
199	Ghehundadi	Panchmahal	-	-	IAR 1970-71
200	Ghelo River (Valabhipur)	Bhavnagar	21° 53' 00" N	71° 55' 00" E	Jairath 1986
201	Ghelri-no Timbo (Anpur)	Bhavnagar	21° 52' 00" N	71° 55' 00" E	Jairath 1986
202	Ghoda DamanbTank (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
203	Ghogamba	Panchmahal	-	-	IAR 1970-71
204	Ghogralu no Timbo (Khijadiya)	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Jairath 1986
205	Ghugamba	Panchmahal	-	-	Sonawane 1976
206	Ghunada	Rajkot	-	-	IAR 1972-73
207	Godadha	Surat	-	-	Patel 1992
208	Godavari One	Jamnagar	22° 12' 00" N	69° 55' 00" E	Bhan 1989
209	Gokalpura	Dhadhar Valley	22° 30' 00" N	73° 35' 00" E	Thomas 1998
210	Gokulpura	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
211	Golan (Purna Valley)	Surat	-	-	IAR 1968-69
212	Golau	Surat	-	-	Patel 1992
213	Gopal Pura	Surat	-	-	IAR 1988-89
214	Gora	Bharuch	-	-	Mehta 1957
215	Gota	Ahmedabad	22° 07' 00" N	72° 32' 00" E	Patel 1992
216	Govindada	Ahmedabad	22° 57' 00" N	72° 47' 00" E	Mirchandani 1981
217	Gudel	Kheda	22° 44' 00" N	72° 31' 00" E	Momin 1979
218	Gunar	Bharuch	-	-	Mehta 1957
219	Gunded	Orsang Valley	22° 09' 00" N	73° 35' 50" E	Ajithprasad 1988
220	Gundia	Bharuch	-	-	IAR 1969-70
221	Gundiviri Four	Orsang Valley	22° 20 ‘ 00" N	73° 39' 00" E	Ajithprasad 1988
222	Hadka Walo Khetar (Datrana Four)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999
223	Haiduk no Thumdo Two (Dehisar Two)	Banaskantha	23° 56' 00" N	71° 31' 00" E	Majumdar 1999
224	Haiduk no Thumdo Two (Santhli Six)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
225	Haldarvas	Kheda	22° 56' 00" N	72° 52' 00" E	Momin 1979
226	Haldravad	Kheda	-	-	Patel 1992
227	Halol	Panchmahals	22° 30' 00" N	73° 29' 00" E	Sonawane 1979
228	Handi	Bharuch	-	-	IAR 1969-70
229	Handi	Surat	-	-	IAR 1961-62
230	Hanuman Kathi	Mehsana	23° 38' 60" N	71° 51' 00" N	Bhan 1994
231	Haraniyava	Ahmedabad	-	-	IAR 1971-72
232	Harasoli	Ahmedabad	-	-	Patel 1992
233	Harhari no Thumdo	Banaskantha	23° 53' 00" N	71° 27' 00" E	Majumdar 1999
234	Haripur	Jamnagar	22° 16' 00" N	70° 01' 00" E	Patel 1992
235	Harnivav	Ahmedabad	22° 56' 50" N	72° 46' 00" E	Mirchandani 1981
236	Harpada	Surat	-	-	IAR 1967-68
237	Hathab	Bhavnagar	21° 35' 00" N	72° 15' 00" E	Jairath 1986
238	Hathijan	Ahmedabad	22° 56' 00" N	72° 46' 00" E	Mirchandani 1981
239	Hatri (Purna Valley)	Surat	-	-	IAR 1968-69
240	Hirapur	Ahmedabad	22° 56' 00" N	72° 42' 00" E	Mirchandani 1981

S.No.	Site Name	District/River	Latitude	Longitude	References
241	Hirapur	Panchmahals	23° 11' 00" N	73° 55' 00" E	Sonawane 1979
242	Hirpur	Ahmedabad	22° 56' 00" N	72° 42' 00" E	Patel 1992
243	Hirpura	Mehsana	-	-	Patel 1992
244	Hod	Orsang Valley	22° 80' 70" N	73° 34' 30" E	Ajithprasad 1988
245	Inderwa-no Timbo Two	Banaskantha	24° 01' 10" N	71° 29' 00" E	Ajithprasad and Sonawane (in press)
246	Indranaj/Indranj	Kheda	22° 30' 00" N	72° 33' 00" E	Momin 1979
247	Indravarna	Bharuch	-	-	Mehta 1957
248	Itwadi	Vadodara	-	-	Mehta 1957
249	Jaban One	Dhadhar Valley	22° 24' 00" N	73° 41' 00" E	Thomas 1998
250	Jaban Three	Dhadhar Valley	22° 24' 00" N	73° 41' 00" E	Thomas 1998
251	Jaidak/Pithad	Jamnagar	22° 40' 00" N	70° 35' 00" E	Rao 1963; IAR 1979-1980; Joshi *et al.* 1984; Possehl 1999
252	Jakhra Pir no Thumdo (Suigam Two)	Banaskantha	24° 07' 00" N	71° 20' 00" E	Majumdar 1999
253	Jalampura	Vadodara	-	-	Mehta 1957
254	Jalat	Panchmahal	-	-	IAR 1968-69
255	Jamalanapada	Surat	-	-	IAR 1967-68
256	Jamkhadi	Surat	-	-	IAR 1987-88
257	Jamnia	Bharuch	-	-	IAR 1969-70
258	Jampha	Bharuch	-	-	IAR 1969-70
259	Janoya-no Timbo	Surendranagar	23° 25' 00" N	71° 51' 20" E	Hegde and Sonawane 1986; Bhan 1994
260	Japa	Orsang Valley	22° 09' 60" N	73° 36' 00" E	Ajithprasad 1988
261	Jarwaliya	Ahmedabad	22° 14' 27" N	71° 55' 31" E	Dimri 1999
262	Jasdan	Rajkot	-	-	IAR 1965-66
263	Jawanpura	Panchmahal	-	-	IAR 1959-60
264	Jhak	Ahmedabad	-	-	Patel 1992
265	Jhalod	Panchmahals	23° 06' 00" N	74° 10' 00" E	Sonawane 1979
266	Jhampa	Bharuch	-	-	IAR 1969-70
267	Jhanjmer	Rajkot	-	-	IAR 1957-58; Ghosh 1989
268	Jinjhar/Jindhar	Ahmedabad	-	-	IAR 1971-72
269	Jitgadh	Bhavnagar	-	-	IAR 1969-70
270	Jitpura	Vadodara	-	-	Mehta 1957
271	Jojwa Ghoda	Orsang Valley	22° 15' 30" N	73° 38' 00" E	Ajithprasad 1988
272	Jokha	Surat	21° 17' 00" N	73° 00' 00" E	Mehta *et al.*1971; IAR 1966-67
273	Jonoyano Timbo	Surendranagar	23° 25' 00" N	71° 27' 00" E	Bhan 1994
274	Juna Deesa	Banaskantha	-	-	Patel 1992
275	Juna Ishnaria	Bhavnagar	-	-	Patel 1992
276	Juna Kantharpur	Ahmedabad	-	-	Patel 1992
277	Juni Kuran	Kachchh	23° 27' 00" N	69° 47' 00" E	Pramanik 2003-2004
278	Junishedi	Mehsana	-	-	Patel 1992
279	Kaap-no-Timbo (Nana Paliyad)	Bhavnagar	22° 17' 00" N	71° 32' 00" E	Jairath 1986
280	Kadachala	Vadodara	-	-	Mehta 1957
281	Kadadara	Ahmedabad	-	-	Patel 1992
282	Kadana Dam	Panchmahals	23° 18' 00" N	73° 42' 00" E	Sonawane 1979
283	Kadod	Surat	-	-	IAR 1966-67
284	Kadod	Surat	-	-	Patel 1992

S.No.	Site Name	District/River	Latitude	Longitude	References
285	Kajli (Purna Valley)	Surat	-	-	IAR 1968-69
286	Kakanpur	Panchmahals	22° 50' 00" N	73° 29' 00" E	Sonawane 1979
287	Kakarda	Surat	-	-	IAR 1967-68
288	Kalatalawadi no Thumdo (Santhli Five)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
289	Kalrio Timbo	Mehsana	23° 36' 60" N	71° 47' 00" E	Bhan 1994
290	Kamboya Timbo	Mehsana	23° 38' 00" N	71° 53' 00" E	Patel 1992
291	Kamixya Timbo	Mehsana	23° 38' 00" N	71° 53' 00" N	Bhan 1994
292	Kamlol Nava	Bhavnagar	-	-	IAR 1979-80
293	Kamod	Ahmedabad	22° 55' 50" N	72° 32' 50" E	Mirchandani 1981
294	Kanewal; Sai no Tekro	Kheda	22° 27' 00" N	72° 30' 00" E	IAR 1972-73; IAR 1974-75; Momin 1979
295	Kanipur	Ahmedabad	23° 09' 00" N	72° 53' 00" E	Mirchandani 1981
296	Kankot	Bhavnagar	-	-	IAR 1979-80
297	Kanmer	Kachchh	23° 23' 00" N	70° 52' 00" E	IAR 1985-86
298	Kantali	Dhadhar Valley	22° 25' 00" N	73° 36' 00" E	Thomas 1998
299	Kapadavanj	Kheda	22° 07' 00" N	73° 21' 00" E	Momin 1979
300	Karachchala	Vadodara	-	-	Mehta 1957
301	Karai	Surat	-	-	IAR 1986-87
302	Karjan	Vadodara	-	-	Mehta 1957
303	Karmali	Vadodara	-	-	Mehta 1957
304	Kasbapa	Surat	-	-	IAR 1966-67
305	Kathairyano Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
306	Kati	Surat	-	-	IAR 1988-89
307	Kava Dam	Panchmahal	-	-	IAR 1972-73
308	Kavitha (Purna Valley)	Surat	-	-	IAR 1968-69
309	Kelamal	Panchmahals	23° 15' 00" N	73° 51' 00" E	Sonawane 1979
310	Keriya no Doro (Keriya)	Bhavnagar	-	-	Jairath 1986
311	Kesarava	Bharuch	-	-	IAR 1968-69
312	Keshav	Junagadh	-	-	IAR 1954-55
313	Kevadia	Bharuch	-	-	Mehta 1957
314	Kevdi	Surat	-	-	IAR 1967-68
315	Khadsaliya	Bhavnagar	21° 33' 00" N	72° 14' 00" E	Jairath 1986
316	Khaksar/Khakasar/Khaknsar	Kheda	22° 27' 00" N	72° 30' 00" E	IAR 1971-72; Momin 1979; Patel 1992
317	Khambia	Surat	-	-	IAR 1971-72
318	Khanjar	Surat	-	-	IAR 1986-87
319	Khanjinu Muwara	Kheda	-	-	Momin 1979
320	Khanpur	Vadodara	-	-	Mehta 1957
321	Khaparia	Valsad	-	-	IAR 1969-70
322	Kharera	Surat	-	-	IAR 1971-72
323	Khaso Timbo	Mehsana	23° 25' 00" N	71° 45' 00" E	Bhan 1994
324	Khedoi	Kachchh	23° 03' 00" N	69° 57' 00" E	IAR 1970-71; 1976-77; Joshi *et al.* 1984
325	Kherap	Dhadhar Valley	22° 28' 00" N	73° 37' 00" E	Thomas 1998
326	Kherio Two (Rampara)	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Jairath 1986
327	Khidhalia Timbo	Mehsana	23° 30' 40" N	71° 48' 00" N	Bhan 1994
328	Khojalwasa	Bharuch	-	-	IAR 1969-70
329	Khonora	Surat	-	-	IAR 1987-88

S.No.	Site Name	District/River	Latitude	Longitude	References
330	Khothawadi Timbo (Bhojavadar)	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
331	Kikakur	Surat	-	-	IAR 1987-88
332	Kikakvi	Surat	-	-	IAR 1988-89
333	Knee Bni na Karo (Pipli)	Bhavnagar	21° 52' 00" N	71° 50' 00" E	Jairath 1986
334	Kota	Jamnagar	22° 10' 00" N	69° 42' 00" E	Joshi *et al.* 1984
335	Kotada	Jamnagar	22° 12' 00" N	70° 22' 00" E	Rao 1963; Possehl 1980; Joshi *et al.* 1984; Bhan 1989
336	Kotai	Jamnagar	22° 10' 00" N	69° 42' 00" E	Patel 1992
337	Kotamda	Surat	-	-	IAR 1967-68
338	Kothara	Vadodara	-	-	Mehta 1957
339	Krakach	Bhavnagar	-	-	IAR 1979-80
340	Krishengdha	Jamnagar	-	-	Bhan 1984
341	Kubadthal	Ahmedabad	22° 03' 00" N	72° 45' 50" E	Patel 1992
342	Kuha Kothia	Ahmedabad	-	-	Patel 1992
343	Kujad	Ahmedabad	-	-	Patel 1992
344	Kukvav	Ahmedabad	23° 23' 50" N	72° 13' 00" E	Patel 1992
345	Kumbharia Timbo	Mehsana	23° 40' 00" N	71° 47' 00" N	Bhan 1994
346	Kuntasi	Rajkot	22° 50' 40" N	70° 37' 30" E	IAR 1977-78; 1987-88; Dhavalikar *et al.* 1996
347	Kuradai	Surat	-	-	Patel 1992
348	Kusalpur	Orsang Valley	22° 10' 80" N	73° 37' 00" E	Ajithprasad 1988
349	Kutharivad	Jamnagar	-	-	IAR 1980-81
350	Kuvadia (Purna Valley)	Surat	-	-	IAR 1968-69
351	Ladai	Kachchh	-	-	IAR 1955-56
352	Lakhabawal	Jamnagar	22° 24' 00" N	70° 00' 00" E	IAR 1955-56; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
353	Lakhapur	Kachchh	23° 33' 00" N	70° 28' 00" E	IAR 1965-66; Ghosh 1989
354	Lakharia no Doro (Timbi)	Bhavnagar	21° 50' 00" N	71° 46' 00" E	Jairath 1986
355	Lakhavad	Bhavnagar	-	-	IAR 1979-80
356	Lakhawad no Doro	Bhavnagar	-	-	Jairath 1986
357	Lakhawad-no-Timbo (Kaniyad)	Bhavnagar	22° 14' 00" N	71° 34' 00" E	Jairath 1986
358	Laloda		-	-	Sonawane 2002
359	Lambha	Ahmedabad	22° 56' 00" N	72° 34' 50" E	Mirchandani 1981
360	Langhnaj	Mahesana	23° 80' 00" N	72° 50' 00" E	Sankalia 1965; Ghosh 1989
361	Laphni Two	Orsang Valley	22° 19' 00" N	73° 41' 00" E	Ajithprasad 1988
362	Ler	Kachchh	-	-	IAR 1967-68
363	Lever	Orsang Valley	26° 16' 40" N	73° 38' 00" E	Ajithprasad 1988
364	Limbavala Khetra	Mehsana	23° 32' 00" N	71° 46' 00" E	Dimri 1999
365	Limbi	Bharuch	-	-	IAR 1969-70
366	Limbuni no Ghod (Suigam One)	Banaskantha	24° 09' 00" N	71° 20' 00" E	Majumdar 1999
367	Limdi	Bharuch	-	-	IAR 1969-70
368	Loteshwar One (Khari no Timbo)	Mehsana	23° 36' 00" N	71° 50' 20" E	Hegde and Sonawane 1986; Bhan 1994

S.No.	Site Name	District/River	Latitude	Longitude	References
369	Lothal	Ahmedabad	22° 31' 25" N	72° 14' 59" E	Rao 1963; 1976;1985; Joshi *et al.* 1984; Possehl 1999
370	Luharwad	Surat	-	-	IAR 1982-83
371	Luni	Kachchh	-	-	IAR 1955-56
372	Machalivad One	Jamnagar	-	-	Bhan 1995
373	Madan Kundala Gondal	Rajkot	-	-	IAR 1983-84
374	Madhapar	Kachchh	-	-	Rao 1963; IAR 1970-71
375	Madhi	Surat	-	-	IAR 1968-69
376	Madhwas	Panchmahals	23° 13' 00" N	73° 36' 00" E	Sonawane 1979
377	Mahadev no Timbo	Banaskantha	-	-	IAR 1964-65
378	Mahakaleshwar	Dungar	23° 49' 00" N	72° 58' 00" E	Sonawane 2002
379	Mahal	Surat	-	-	IAR 1967-68
380	Mahijda	Ahmedabad	22° 49' 00" N	72° 32' 50" E	Mirchandani 1981
381	Mahudi	Surat	-	-	IAR 1988-89
382	Mahuva (Purna Valley)	Surat	-	-	IAR 1968-69
383	Majipur	Vadodara	-	-	Mehta 1957
384	Majipura	Kheda	-	-	Momin 1979
385	Makaragadh	Kachchh	-	-	IAR 1967-68
386	Makhaniya Hill	Vadodara	22° 27' 00" N	73° 51' 00" E	Sonawane 2002
387	Mal	Panchmahals	23° 16' 00" N	73° 41' 00" E	Sonawane 1979
388	Maliapur	Mehsana	-	-	Patel 1992
389	Malnawara	Bhavnagar	-	-	IAR 1979-80
390	Malwan	Surat	21° 06' 00" N	72° 43' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
391	Man	Panchmahal	-	-	IAR 1972-73
392	Mangadh	Panchmahal	-	-	IAR 1971-72
393	Mangrol	Bharuch	-	-	Mehta 1957
394	Mankwa	Kheda	22° 52' 00" N	72° 55' 00" E	Momin 1979
395	Manpur	Panchmahal	-	-	IAR 1972-73
396	Mathutra	Banaskantha	23° 44' 00" N	71° 05' 00" E	Ajithprasad and Sonawane (in press)
397	Mavlipada	Surat	-	-	IAR 1967-68
398	Mayo no khado (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	IAR 1957-58; Ghosh 1989
399	Medakui	Vadodara	-	-	Mehta 1957
400	Medapur	Panchmahals	22° 35' 00" N	73° 30' 00" E	Sonawane 1979
401	Medha	Surat	-	-	IAR 1988-89
402	Mehgam	Bharuch	-	-	IAR 1957-58
403	Mehmudpura	Kheda	23° 12' 00" N	73° 28' 00" E	Momin 1979
404	Mekada	Bhavnagar	-	-	IAR 1979-80
405	Meroli	Ahmedabad	22° 52' 00" N	72° 52' 50" E	Mirchandani 1981
406	Mewu	Mehsana	-	-	Patel 1992
407	Mitli	Kheda	22° 25' 00" N	72° 24' 00" E	Momin 1979
408	Miyapur (Purna Valley)	Surat	-	-	IAR 1968-69
409	Modasa	Sabarkantha	-	-	IAR 1958-59
410	Modpar One	Jamnagar	-	-	Bhan 1986
411	Modpar Three	Jamnagar	-	-	Bhan 1988
412	Modpar Two	Jamnagar	-	-	Bhan 1987
413	Mogawa	Surat	-	-	IAR 1988-89
414	Mokhadi	Bharuch	-	-	Mehta 1957

S.No.	Site Name	District/River	Latitude	Longitude	References
415	Molio Timbo	Mehsana	23° 46' 00" N	71° 43' 00" N	Bhan 1994
416	Monpur One	Orsang Valley	22° 09' 50" N	73° 35' 00" E	Ajithprasad 1988
417	Monpur Two	Orsang Valley	22° 12' 50" N	73° 42' 50" E	Ajithprasad 1988
418	Morgana	Vadodara	-	-	Mehta 1957
419	Mota Ratnakar	Kheda	22° 59' 00" N	73° 05' 00" E	Momin 1979
420	Mota-Andhra	Bharuch	-	-	Mehta 1957
421	Motacharya	Surat	-	-	IAR 1967-68
422	Mota-Khara (Langala)	Bhavnagar	21° 48' 00" N	71° 43' 00" E	IAR 1961-62; Ghosh 1989
423	Moti Bhamri	Bharuch	-	-	IAR 1969-70
424	Moti Gop	Jamnagar	-	-	Bhan 1990
425	Moti Phalod	Surat	-	-	IAR 1971-72
426	Moti Pipli	Banaskantha	23° 49' 00" N	71° 32' 00" E	Majumdar 1999
427	Movi	Bharuch	-	-	IAR 1969-70
428	Muai Ashram	Vadodara	-	-	IAR 1983-84
429	Mulajidosa No Ghodo	Vadodara	-	-	Mehta 1957
430	Mullada One	Surendranagar	23° 18' 00" N	71° 44' 00" E	Bhan 1994
431	Mulson	Mehsana	-	-	Patel 1992
432	Munpur	Panchmahals	23° 17' 00" N	73° 48' 00" E	Sonawane 1979
433	Muvado	Ahmedabad	-	-	Patel 1992
434	Nadhanpur	Kheda	22° 30' 00" N	73° 25' 00" E	Momin 1979
435	Nadisar	Panchmahals	22° 53' 00" N	73° 24' 00" E	Sonawane 1979
436	Nagadia/Nagadiya	Jamnagar	21° 55' 00" N	69° 33' 00" E	IAR 1979-80
437	Nageswar	Jamnagar	22° 18' 00" N	69° 02' 00" E	IAR 1980-81; 1983-84; Bhan 1986; Hegde *et al.* 1990
438	Nagro Tikro	Orsang Valley	22° 08' 60" N	73° 38' 00" E	Ajithprasad 1988
439	Nagwada	Surendranagar	23° 18' 15" N	71° 42' 45" E	IAR 1984-85
440	Naj	Ahmedabad	22° 53' 00" N	72° 34' 00" E	Mirchandani 1981
441	Nana Khara (Langala)	Bhavnagar	21° 48' 00" N	71° 43' 00" E	Jairath 1986
442	Nana Sapaka	Surendranagar	22° 21' 57" N	71° 35' 53" E	Dimri 1999
443	Nanapada	Surat	-	-	IAR 1967-68
444	Nandol	Ahmedabad	23° 18' 50" N	72° 49' 00" E	Patel 1992
445	Nangal	Bharuch	-	-	IAR 1959-60
446	Nani Bahari (Purna Valley)	Surat	-	-	IAR 1968-69
447	Nani Chandur	Mehsana	23° 35' 00" N	71° 37' 30" E	Bhan 1994
448	Nani Chur	Mehsana	23° 35' 00" N	71° 37' 30" E	Bhan 1994
449	Nani Nikole	Bharuch	-	-	IAR 1971-72
450	Nashado Two	Ahmedabad	22° 15' 00" N	71° 52' 12" E	Dimri 1999
451	Nava Vaghpura (Jetpur)	Bharuch	-	-	IAR 1969-70
452	Navagam	Bharuch	-	-	IAR 1969-70
453	Navagam (Gaekwad)	Bhavnagar	21° 55' 00" N	71° 53' 00" E	Jairath 1986
454	Navagam (Zarmarmata)	Panchmahals	23° 25' 00" N	73° 40' 00" E	Sonawane 1979
455	Navapura	Mehsana	23° 36' 50" N	71° 51' 60" N	Bhan 1994
456	Navod no Thumdo (Santhli Four)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
457	Nesatalavawala Timbo	Mehsana	23° 40' 00" N	71° 47' 00" N	Bhan 1994
458	Nesda (Nana Paliyad)	Bhavnagar	22° 10' 00" N	71° 31' 00" E	Jairath 1986
459	Nesdi (Valabhi)	Bhavnagar	21° 53' 00" N	71° 55' 00" E	Jairath 1986
460	Nichadi	Bhavnagar	-	-	IAR 1979-80
461	Nikna	Jamnagar	22° 11' 00" N	70° 36' 00" E	Patel 1992
462	Nol	Ahmedabad	23° 18' 50" N	72° 49' 00" E	Mirchandani 1981
463	Nothala	Surat	-	-	IAR 1968-69

S.No.	Site Name	District/River	Latitude	Longitude	References
464	Ode	Ahmedabad	22° 55' 00" N	72° 33' 00" E	Mirchandani 1981
465	Odee Ka Talia (Nasitpur)	Bhavnagar	22° 24' 00" N	71° 50' 00" E	Jairath 1986
466	Okado Timbo	Mehsana	23° 37' 40" N	71° 50' 80" N	Bhan 1994
467	Ood no Doro (Juna Ishvariya)	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Jairath 1986
468	Oriyo Timbo	Bhavnagar	21° 53' 12" N	71° 36' 16" E	IAR 1984-85; Rissman and Chitalwala 1990
469	Pabumath	Kachchh	23° 37' 00" N	70° 31' 40" E	IAR 1977-78; Possehl 1980;1999; Joshi *et al.* 1984
470	Padar no Timbo (Khijadiya)	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Jairath 1986
471	Padardi	Sabar Kantha	-	-	IAR 1970-71
472	Padra	Kheda	-	-	IAR 1971-72
473	Padri	Bhavnagar	21° 20' 21" N	72° 06' 32" E	Shinde 1992
474	Pahera	Mehsana	23° 31' 00" N	71° 33' 00" N	Bhan 1994
475	Pal	Rajkot	-	-	IAR 1964-65
476	Palanpar no Timbo	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
477	Palipur	Mehsana	23° 38' 40" N	71° 51' 50" E	Patel 1992
478	Paliyad	Bhavnagar	22° 10' 00" N	71° 31' 00" E	Jairath 1986
479	Palsunda		22° 23' 50" N	73° 53' 50" E	Sonawane 2002
480	Panchwada	Panchmahals	22° 45' 00" N	74° 16' 00" E	Sonawane 1979
481	Pandva	Kheda	-	-	Patel 1992
482	Panva	Surendranagar	-	-	Patel 1992
483	Parodi	Bharuch	-	-	IAR 1970-71
484	Paro-no-Timbo (Juna Ishvariya)	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Jairath 1986
485	Pasanj	Ahmedabad	-	-	Patel 1992
486	Pasegam	Bhavnagar	-	-	Patel 1992
487	Pasunj	Ahmedabad	23° 04' 00" N	72° 48' 00" E	Mirchandani 1981
488	Patadungri	Panchmahal	-	-	Sonawane 1976
489	Patal	Bharuch	-	-	IAR 1969-70
490	Patana-no Timbo (Patana)	Bhavnagar	21° 51' 00" N	71° 32' 00" E	Jairath 1986
491	Patel Phalia	Bharuch	-	-	IAR 1979-80
492	Patharia	Panchmahal	-	-	IAR 1969-70
493	Pati no Timbo (Pati)	Bhavnagar	21° 51' 00" N	71° 51' 00" E	Jairath 1986
494	Pavagadh	Dhadhar Valley	22° 28' 00" N	73° 33' 00" E	Thomas 1998
495	Pavagadh	Panchmahals	22° 31' 00" N	73° 31' 00" E	Sonawane 1979
496	Pedhamli	Mehsana	-	-	Patel 1992
497	Petia	Bharuch	-	-	IAR 1969-70
498	Phajalpur	Vadodara	-	-	Mehta 1957
499	Phathodra	Ahmedabad	-	-	Patel 1992
500	Pingi no Timbo One	Ahmedabad	22° 19' 52" N	72° 00' 35" E	Dimri 1999
501	Pipalsat	Orsang Valley	22° 08' 90" N	73° 33' 00" E	Ajithprasad 1988
502	Piparia	Bharuch	-	-	IAR 1960-61
503	Piparia	Orsang Valley	22° 08' 20" N	73° 34' 30" E	Ajithprasad 1988
504	Pitavadi	Bhavnagar	-	-	IAR 1979-80
505	Pitvajal	Bhavnagar	-	-	IAR 1979-80
506	Pol	Dhadhar Valley	22° 27' 00" N	73° 39' 00" E	Thomas 1998
507	Prabhas Patan (Somnath)	Junagadh	20° 53' 00" N	70° 24' 00" E	Nanavati *et al.* 1971; Dhavalikar and Possehl 1992
508	Prahladgadh	Bhavnagar	-	-	Patel 1992
509	Pva	Kheda	23° 06' 00" N	73° 21' 00" E	Momin 1979
510	Raipara/Raipura	Bharuch	-	-	IAR 1969-70

S.No.	Site Name	District/River	Latitude	Longitude	References
511	Rajalwada	Bharuch	-	-	IAR 1968-69
512	Rajasar no Timbo	Mehsana	23° 05' 00" N	71° 33' 00" N	Bhan 1994
513	Rajgadh	Panchmahals	22° 33' 00" N	73° 41' 00" E	Sonawane 1979
514	Rajpari	Orsang Valley	22° 19' 00" N	73° 38' 60" E	Ajithprasad 1988
515	Rajpipla	Bharuch	-	-	Mehta 1957
516	Rajpipla One	Bhavnagar	21° 53' 00" N	71° 39' 00" E	Jairath 1986
517	Rajpipla Three	Bhavnagar	-	-	Patel 1992
518	Rajpipla Two	Bhavnagar	-	-	Patel 1992
519	Rajpura	Bharuch	-	-	IAR 1965-66
520	Rajpura	Vadodara	-	-	Mehta 1957
521	Rajthali	Bhavnagar	-	-	IAR 1979-80
522	Rajwada	Jamnagar	22° 09' 00" N	70° 22' 00" E	Patel 1992
523	Rajwadio Timbo One	Mehsana	23° 35' 00" N	71° 51' 00" N	Bhan 1994
524	Rambhas	Surat	-	-	IAR 1967-68
525	Rambhau	Kachchh	-	-	IAR 1955-56
526	Ramgadh Two	Bharuch	-	-	Mehta 1957
527	Ramnod	Rajkot	-	-	IAR 1958-59
528	Ramol	Ahmedabad	23° 59' 00" N	72° 39' 50" E	Mirchandani 1981
529	Rampur	Mehsana	-	-	Patel 1992
530	Rampura (Karza)	Banaskantha	-	-	IAR 1958-59
531	Ranat (Purna Valley)	Surat	-	-	IAR 1968-69
532	Ranavasa	Banaskantha	-	-	Parikh 1977
533	Randevi	Bharuch	-	-	Patel 1992
534	Rangola	Bhavnagar	21° 47' 00" N	71° 38' 00" E	Jairath 1986
535	Rangpur	Surendranagar	22° 26' 00" N	71° 55' 00" E	Rao 1963
536	Rangpur-no Timbo (Haliad)	Bhavnagar	21° 53' 00" N	71° 50' 00" E	Jairath 1986
537	Ranifalia	Valsad	-	-	IAR 1968-69
538	Ranipura	Bharuch	-	-	IAR 1970-71
539	Ranpur	Ahmedabad	22° 45' 00" N	72° 34' 50" E	Mirchandani 1981
540	Rapamora	Jamnagar	22° 60' 00" N	69° 45' 00" E	Patel 1992
541	Rasnalia-no Timbo (Patana)	Bhavnagar	21° 51' 00" N	71° 32' 00" E	Jairath 1986
542	Ratan Tekra	Banaskantha	-	-	Patel 1992
543	Ratan Tekri	Banaskantha	-	-	IAR 1963-64
544	Ratanpura	Mehsana	23° 28' 00" N	71° 48' 00" E	IAR 1984-85
545	Raval One	Mehsana	23° 38' 00" N	71° 51' 00" E	Patel 1992
546	Raval Three	Mehsana	23° 38' 40" N	71° 51' 50" E	Patel 1992
547	Raval Two	Mehsana	23° 38' 00" N	71° 51' 50" E	Patel 1992
548	Ravaliya	Kheda	22° 04' 00" N	73° 22' 00" E	Momin 1979
549	Ravalnani	Bharuch	-	-	Mehta 1957
550	Rawad One	Mehsana	23° 38' 40" N	71° 51' 00" N	Bhan 1994
551	Rawad Two	Mehsana	23° 38' 40" N	71°51' 50" N	Bhan 1994
552	Raypur		22° 26' 00" N	73° 50' 00" E	Sonawane 2002
553	Rel	Bharuch	-	-	IAR 1969-70
554	Rena	Panchmahals	22° 55' 00" N	73° 29' 00" E	Sonawane 1979
555	Rhalia no Timbo	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
556	Rohiodas no Timbo (Navagam Gaekwad)	Bhavnagar	21° 53' 00" N	71° 49' 00" E	Jairath 1986
557	Rojdi	Rajkot	21° 51' 47" N	70° 55' 08" E	IAR 1957-58; Rao 1963; Possehl and Rawal 1989
558	Rugnathparu	Bhavnagar	-	-	IAR 1979-80
559	Runi	Mehsana	23° 28' 00" N	71° 58' 00" E	Patel 1992
560	Rupankui	Vadodara	-	-	Mehta 1957

S.No.	Site Name	District/River	Latitude	Longitude	References
561	Rupavati	Bhavnagar	-	-	IAR 1979-80
562	Rupavati- Doro (Piparali)	Bhavnagar	21° 40' 00" N	71° 45' 00" E	Jairath 1986
563	Saaheer-no Timbo (Bhadi)	Bhavnagar	-	-	Jairath 1986
564	Sajroli-Mo	Bharuch	-	-	Mehta 1957
565	Sakarpatal	Surat	-	-	IAR 1967-68
566	Salampur	Vadodara	-	-	Mehta 1957
567	Samadhi Timbo (Samadhiala)	Bhavnagar	21° 52' 00" N	71° 41' 00" E	Jairath 1986
568	Sambaria	Bharuch	-	-	IAR 1969-70
569	Samdhi	Orsang Valley	22° 16' 80" N	73° 39' 50" E	Ajithprasad 1988
570	Samsabad	Vadodara	-	-	Mehta 1957
571	Sanad	Ahmedabad	22° 45' 00" N	73° 32' 50" E	Patel 1992
572	Sandalpur	Vadodara	-	-	Mehta 1957
573	Sandasal	Vadodara	-	-	Mehta 1957
574	Sangana Nava	Bhavnagar	-	-	IAR 1979-80
575	Sanosara	Kachchh	-	-	Patel 1992
576	Santalpur	Banaskantha	-	-	Patel 1992
577	Santhli Five	Banaskantha	23° 54' 15" N	71° 29' 50" E	Ajithprasad and Sonawane (in press)
578	Santhli Four	Banaskantha	23° 54' 00" N	71° 28' 50" E	Ajithprasad and Sonawane (in press)
579	Santhli One	Banaskantha	23° 41' 00" N	71° 29' 00" E	Majumdar 1999
580	Santhli Six	Banaskantha	23° 54' 00" N	71° 30' 20" E	Ajithprasad and Sonawane (in press)
581	Santhli Three	Banaskantha	23° 53' 50" N	71° 29' 00" E	Ajithprasad and Sonawane (in press)
582	Santhli Two	Banaskantha	23° 54' 00" N	71° 29' 10" E	Ajithprasad and Sonawane (in press)
583	Santrampur	Panchmahals	23° 12' 00" N	73° 54' 00" E	Sonawane 1979
584	Sarali	Kachchh	-	-	Patel 1992
585	Sarangapur	Bhavnagar	-	-	IAR 1979-80
586	Saraswati	Mahesana	-	-	IAR 1956-57
587	Sarota	Banaskantha	-	-	Patel 1992
588	Sarwania	Jamnagar	-	-	Bhan 1996
589	Sayakhan ni Wadi	Kachchh	-	-	IAR 1967-68
590	Sejakpur	Surendranagar	-	-	IAR 1957-58
591	Sejpur	Bharuch	-	-	IAR 1969-70
592	Sevati	Surat	-	-	IAR 1988-89
593	Shedravadar	Bhavnagar	-	-	IAR 1979-80
594	Shekhapur (Purna Valley)	Surat	-	-	IAR 1968-69
595	Sherdi	Jamnagar	-	-	IAR 1954-55
596	Shetpur	Vadodara	-	-	Mehta 1957
597	Shikarpur	Kachchh	23° 07' 00" N	70° 35' 00" E	IAR 1986-87
598	Shiyal/Magvana Timbo	Ahmedabad	-	-	Patel 1992
599	Shiyali	Bharuch	-	-	IAR 1971-72
600	Sidsar	Bhavnagar	-	-	IAR 1980-81
601	Sihor	Bhavnagar	21° 43' 00" N	72° 00' 00" E	Jairath 1986
602	Singana	Surat	-	-	IAR 1967-68
603	Singana	Vadodara	-	-	Mehta 1957
604	Siyanagar	Bhavnagar	22° 02' 00" N	71° 41' 00" E	Jairath 1986
605	Sonada	Kheda	-	-	Patel 1992
606	Songir	Vadodara	-	-	Mehta 1957
607	Surajwada	Bharuch	-	-	Mehta 1957
608	Surali	Surat	-	-	IAR 1968-69

S.No.	Site Name	District/River	Latitude	Longitude	References
609	Sureli	Panchmahals	22° 38' 00" N	73° 29' 00" E	Sonawane 1979
610	Surkotada	Kachchh	23° 37' 00" N	70° 50' 00" E	IAR 1964-65; Possehl 1980; 1999; Joshi *et al.* 1984
611	Tadach	Bhavnagar	-	-	IAR 1979-80
612	Tajpura	Dhadhar Valley	22° 25' 00" N	73° 30' 00" E	Thomas 1998
613	Tajpura	Panchmahals	22° 27' 00" N	73° 20' 00" E	Sonawane 1979
614	Talawadi One	Dhadhar Valley	22° 27' 00" N	73° 40' 00" E	Thomas 1998
615	Talawadi Two	Dhadhar Valley	22° 27' 00" N	73° 40' 00" E	Thomas 1998
616	Taldara	Bharuch	-	-	Patel 1992
617	Talia	Bhavnagar	-	-	IAR 1979-80
618	Talia Ghoda	Orsang Valley	22° 09' 00" N	73° 34' 50" E	Ajithprasad 1988
619	Taliaghoda	Vadodara	-	-	Mehta 1957
620	Tanchasar	Mehsana	23° 25' 00" N	71° 48' 00" E	Patel 1992
621	Taragraha	Bhavnagar	-	-	Jairath 1986
622	Tarana Three	Jamnagar	-	-	Patel 1992
623	Tarsang	Panchmahals	22° 56' 00" N	73° 28' 00" E	Sonawane 1979; 1982
624	Tatam	Bhavnagar	22° 04' 00" N	71° 36' 00" E	Jairath 1986
625	Tavali	Surat	-	-	IAR 1988-89
626	Tejpur	Bharuch	-	-	IAR 1971-72
627	Telnar	Kheda	22° 07' 00" N	73° 02' 00" E	Momin 1979
628	Teraon Timbo	Vadodara	-	-	Mehta 1957
629	Thaltej	Ahmedabad	-	-	Patel 1992
630	Thangadh	Surendranagar	-	-	IAR 1991-92
631	Thapnath (Chogath)	Bhavnagar	21° 50' 00" N	71° 50' 00" E	Jairath 1986
632	Thaverpur	Vadodara	-	-	Patel 1992
633	Thesaria	Banaskantha	-	-	IAR 1964-65
634	Thumba	Banaskantha	-	-	Bhan 1994
635	Thumda One	Mehsana	-	-	Bhan 1994
636	Thumda Two	Mehsana	-	-	Bhan 1994
637	Timana	Bhavnagar	-	-	IAR 1979-80
638	Timba	Ahmedabad	22° 08' 00" N	72° 32' 50" E	Mirchandani 1981
639	Timbi One	Jamnagar	-	-	IAR 1980-81
640	Timbnigatha	Surat	-	-	IAR 1967-68
641	Timbo	Ahmedabad	22° 20' 50" N	71° 49' 51" E	Dimri 1999
642	Timbo One	Ahmedabad	22° 18' 03" N	71° 48' ‘ 23" E	Dimri 1999
643	Timbo Two	Ahmedabad	22° 19' 52" N	72° 00' 35" E	Majumdar 1999
644	Timbu	Jamnagar	-	-	Patel 1992
645	Todia/Todiya	Kheda	-	-	Momin 1979; Patel 1992
646	Tokaria Timbo	Mehsana	23° 28' 00" N	71° 49' 30" E	IAR 1982-83; Bhan 1994
647	Triveni Sangam	Jamnagar	-	-	Bhan 1986
648	Ubhad	Surat	-	-	IAR 1982-83
649	Udrel	Ahmedabad	-	-	IAR 1970-71
650	Ujalvav-no-Timbo (Ujalvav)	Bhavnagar	22° 03' 00" N	71° 53' 00" E	Jairath 1986
651	Uman	Bharuch	-	-	IAR 1970-71
652	Umrwa	Bharuch	-	-	IAR 1969-70
653	Unchidhanal	Sabarkantha	-	-	IAR 1970-71
654	Undar	Panchmahal	-	-	IAR 1968-69
655	Undrel	Ahmedabad	22° 58.5' 00" N	72° 46' 00" E	Mirchandani 1981
656	Upsal	Valsad	-	-	IAR 1968-69
657	Vadad	Kheda	22° 27' 00" N	73° 04' 00" E	Patel 1992

S.No.	Site Name	District/River	Latitude	Longitude	References
658	Vadadi no Timbo	Mehsana	23° 35' 00" N	71° 53' 00" E	Majumdar 1999
659	Vadakhavantha	Bharuch	-	-	Patel 1992
660	Vadakhunta	Bharuch	-	-	IAR 1968-69
661	Vadaval	Banaskantha	-	-	Parikh 1977
662	Vadgam	Bharuch	-	-	IAR 1979-80
663	Vad-Ghrudeshwar	Bharuch	-	-	Mehta 1957
664	Vadi	Panchmahals	22° 55' 00" N	73° 26' 00" E	Sonawane 1979
665	Vadi Tarsang	Panchmahal	-	-	IAR 1971-72
666	Vadia	Bharuch	-	-	Mehta 1957
667	Vadia One	Vadodara	-	-	Patel 1992
668	Vadval	Banaskantha	-	-	Patel 1992
669	Vagad	Ahmedabad	22o 19' 00" N	71o 52' 00" E	Sonawane and Mehta 1985
670	Vagadia	Bharuch	-	-	Mehta 1957
671	Vagech (Purna Valley)	Surat	-	-	IAR 1968-69
672	Vaidwali Mohra	Kachchh	-	-	IAR 1985-86
673	Vaijiyasari no Thumdo (Santhli Three)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
674	Vakharia	Surat	-	-	IAR 1967-68
675	Valabhipur	Bhavnagar	22° 41' 15" N	71° 38' ' 31" E	Jairath 1986
676	Vala-no Timbo (Karala)	Bhavnagar	21° 59' 00" N	71° 29' 00" E	Jairath 1986
677	Valasana	Mehsana	-	-	Patel 1992
678	Valbai-no Timbo (Turkha)	Bhavnagar	22° 08' 00" N	71° 32' 00" E	Jairath 1986
679	Vallara	Banaskantha	-	-	Parikh 1977
680	Vallavpur	Panchmahals	22° 54' 00" N	73° 24' 00" E	Sonawane 1979
681	Valli	Kheda	22° 28' 00" N	72° 30' 00" E	Momin 1979
682	Valod	Surat	-	-	IAR 1968-69
683	Valukans	Kheda	-	-	Momin 1979
684	Vanali no Timbo (Vanali)	Bhavnagar	21° 54' 00" N	71° 35' 00" E	Jairath 1986
685	Vanch	Ahmedabad	-	-	Patel 1992
686	Vandariya	Bharuch	-	-	Mehta 1957
687	Vankia	Bhavnagar	-	-	IAR 1979-80
688	Vaodi	Bharuch	-	-	IAR 1969-70
689	Varvada	Vadodara	-	-	Mehta 1957
690	Vasai	Ahmedabad	22° 50' 50" N	72° 32' 50" E	Mirchandani 1981
691	Vasana	Banaskantha	-	-	Parikh 1977
692	Vashi	Ahmedabad	22° 50' 50" N	72° 32' 50" E	Patel 1992
693	Vasmed	Mehsana	-	-	Patel 1992
694	Vastana	Kheda	22° 35' 00" N	73° 33' 00" E	Momin 1979
695	Vastral	Ahmedabad	22° 01' 00" N	72° 39' 00" E	Mirchandani 1981
696	Vatkiwalu Khetar One (Datrana Five)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999
697	Vatroli	Kheda	-	-	Patel 1992
698	Vavdi	Bharuch	-	-	IAR 1969-70
699	Vavri	Dhadhar Valley	22° 27' 00" N	73° 38' 00" E	Thomas 1998
700	Vejalpur	Vadodara	-	-	IAR 1982-83
701	Vejalpur	Bharuch	-	-	IAR 1957-58
702	Velavadar	Bhavnagar	-	-	IAR 1979-80
703	Vernatha	Mehsana	23° 38' 00" N	71° 54' 00" E	Bhan 1994
704	Vhali-no Timbo (Bhadravadi)	Bhavnagar	22° 13' 00" N	71° 33' 00" E	Jairath 1986
705	Vidwas-Wami Mata Hill	Orsang Valley	22° 10' 80" N	73° 37' 00" E	Ajithprasad 1988
706	Vikrarambhai no Timbo	Ahmedabad	22° 18' 20" N	72° 01' 02" E	Dimri 1999
707	Virpur	Bharuch	-	-	Mehta 1957

S.No.	Site Name	District/River	Latitude	Longitude	References
708	Virpur	Vadodara	-	-	Patel 1992
709	Virpur-no Timbo (Haripar)	Bhavnagar	21° 59' 00" N	71° 32' 00" E	Jairath 1986
710	Visadi	Panchmahals	22° 14' 00" N	73° 43' 00" E	Sonawane 1979
711	Vyara	Surat	-	-	IAR 1968-69
712	Wai	Surat	-	-	IAR 1967-68
713	Wankla	Surat	-	-	IAR 1982-83
714	Wareth	Surat	-	-	IAR 1982-83
715	Wasarono Timbo	Mehsana	23° 32' 00" N	71° 45' 00" N	Bhan 1994
716	Zanariano Timbo	Surendranagar	23° 26' 00" N	71° 44' 00" N	Bhan 1994
717	Zanzpore	Bharuch	-	-	IAR 1968-69
718	Zaran	Surat	-	-	IAR 1967-68
719	Zekhada/Jekhda	Banaskantha	23° 51' 00" N	71° 28' 00" E	Mehta 1982

Table 6: Neolithic sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Akkadia Mota	Amreli	-	-	Ghosh 1989
2	Damnagar	Amreli	-	-	IAR 1969-70
3	Dolapura	Vadodara	-	-	IAR 1983-84
4	Jokha	Surat	21° 17' 00" N	73° 00' 00" E	Mehta and Chaudhary 1971

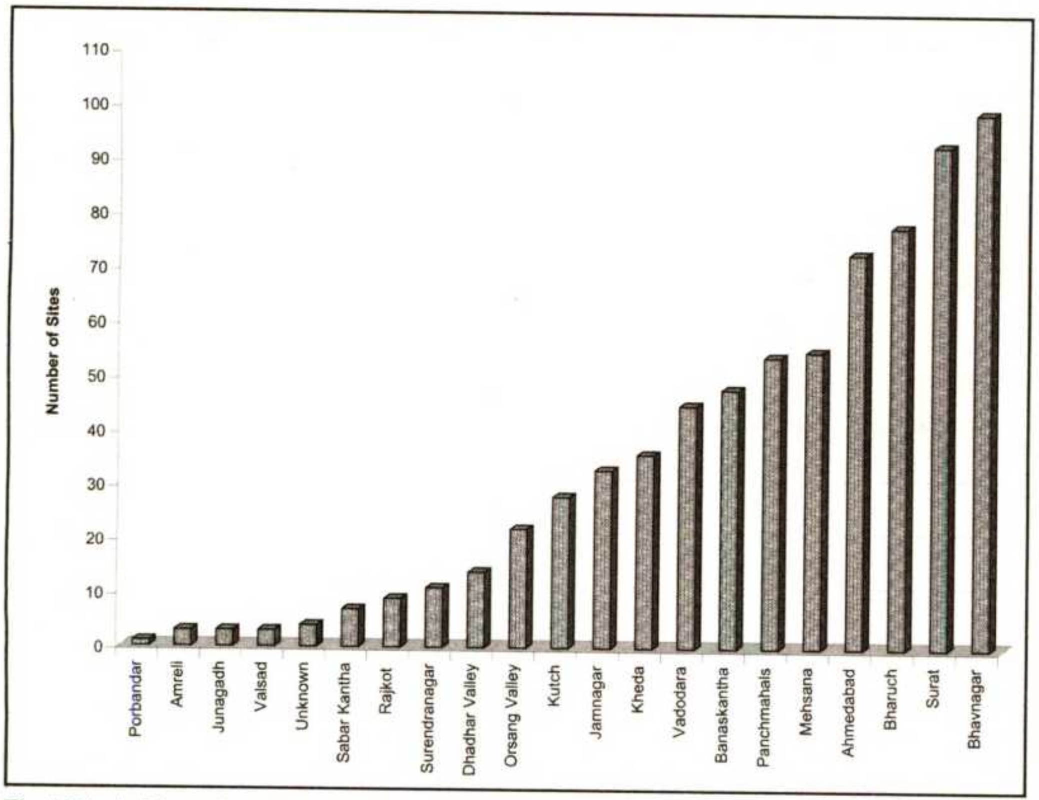

Fig. 5 District/River-wise distribution of Mesolithic sites in Gujarat

Table 7: Pre-Urban Harappan sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Bajaniya-no-Thumdo	Banaskantha	23° 49' 40" N	71° 29' 30" E	Ajithprasad and Sonawane (in press)
2	Bhamaria Thumdo	Banaskantha	23° 54' 00" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
3	Choteria Timbo	Mehsana	23° 36' 00" N	71° 51' 00" E	Bhan 1994
4	Dholavira	Kachchh	23° 53' 10" N	70° 13' 00" E	IAR 1967-68; Joshi *et al.* 1984; Bisht 1989a; 1991; 1994; 2004
5	Ghachiya Wado (Santhli Two)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
6	Gokhijadio-no Timbo	Mehsana	23° 37' 00" N	71° 52' 30" E	Bhan 1994
7	Loteshwar (Khari no Timbo)	Mehsana	23° 36' 00" N	71° 50' 20" E	Hegde and Sonawane 1986; Bhan 1994
8	Madhvya-no Timbo (Mathutra)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Ajithprasad and Sonawane (in press)
9	Modhera	Mehsana	-	-	Rao 1963; Ghosh 1989
10	Moti Pipli	Banaskantha	23° 49' 25" N	71° 31' 00" E	Bhan 1994
11	Nagwada One	Surendranagar	23° 18' 15" N	71° 42' 45" E	IAR 1984-85; Ajithprasad and Sonawane 1993
12	Navod no Thumdo (Santhli Four)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
13	Padri	Bhavnagar	21° 20' 21" N	72° 06' 32" E	Shinde 1992a; 1992b; Shinde *et al.* 1992
14	Prabhas Patan (Somnath)	Junagadh	20° 53' 00" N	70° 24' 00" E	Nanavati *et al.*1971; Ghosh 1989
15	Shakatri Timbo	Banaskantha	23° 49' 00" N	71° 32' 00" E	Majumdar 1999
16	Surkotada	Kachchh	23° 37' 00" N	70° 50' 00" E	IAR 1964-65; Possehl 1980; 1999; Joshi *et al.* 1984

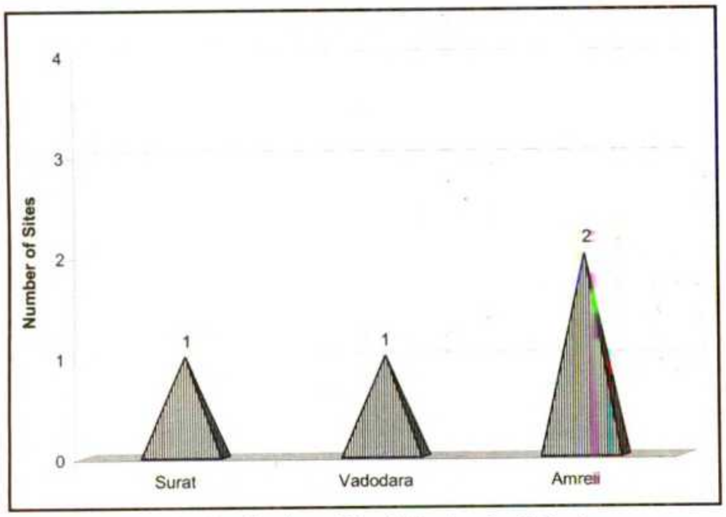

Fig. 6 District-wise distribution of Neolithic sites in Gujarat

Table 8: Pre-Urban Harappan burial pottery sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Bajaniya-no-Thumdo	Banaskantha	23° 49' 40" N	71° 29' 30" E	Ajithprasad and Sonawane (in press)
2	Bhamaria Thumdo	Banaskantha	23° 54' 00" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
3	Dholavira	Kachchh	23° 53' 10" N	70° 13' 00" E	IAR 1967-68; Joshi *et al.* 1984; Bisht 1989b; 1991; 1994; 2004
4	Ghachiya Wado (Santhli Two)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
5	Madhvya-no Timbo (Mathutra)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Ajithprasad and Sonawane (in press)
6	Moti Pipli	Banaskantha	23° 49' 25" N	71° 31' 00" E	Bhan 1994
7	Nagwada One	Surendranagar	23° 18' 15" N	71° 42' 45" E	IAR 1984-85
8	Navod no Thumdo (Santhli Four)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
9	Shakatri Timbo	Banaskantha	23° 49' 00" N	71° 32' 00" E	Majumdar 1999

Table 9: Anarta Tradition/Culture sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Amasino Tekro	Banaskantha	23° 32' 00" N	71° 29' 00" E	Bhan 1994
2	Bagasra (Gola Dhoro)	Rajkot	22° 50' 00" N	70° 41' 00" E	Sonawane *et al.* 2003; Bhan *et al.*2005
3	Bagaya no Timbo	Mehsana	23° 25' 30" N	71° 49' 30" E	Hegde and Sonawane 1986; Bhan 1994
4	Bhamaria Thumdo	Banaskantha	23° 54' 00" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
5	Bhutawed no Godh	Banaskantha	23° 51' 00" N	71° 23' 00" E	Ajithprasad and Sonawane (in press)

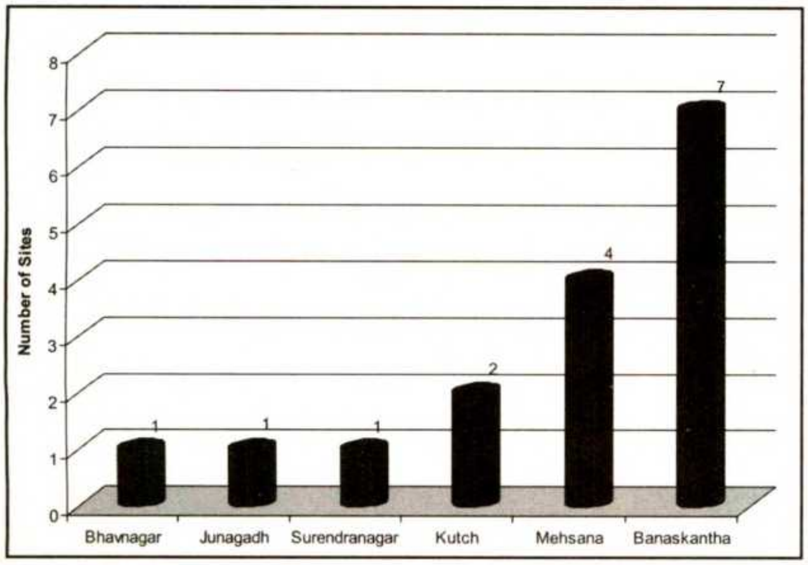

Fig. 7 District-wise distribution of Pre-Urban Harappan sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
6	Bolera	Mehsana	23° 29' 00" N	71° 45' 20" E	Bhan 1994
7	Choteria Timbo	Mehsana	23° 36' 00" N	71° 51' 00" E	Bhan 1994
8	Datrana Eight	Banaskantha	23° 46' 00" N	71° 06' 45" E	Ajithprasad and Sonawane (in press)
9	Datrana Five	Banaskantha	23° 46' 15" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
10	Datrana Seven	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
11	Datrana Six	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
12	Dhama	Surendranagar	23° 23' 00" N	71° 39' 00" E	Bhan 1994
13	Duderia Timbo (Panchasar Two)	Mehsana	23° 25' 00" N	71° 48' 00" E	Majumdar 1999
14	Footariya	Mehsana	23° 37' 00" N	71° 43' 00" E	Bhan 1994
15	Gachi no Bor (Munjpur Two)	Mehsana	23° 36' 00" N	71° 53' 00" E	Majumdar 1999
16	Ganario-no Thumdo	Banaskantha	23° 56' 10" N	71° 31' 00" E	Ajithprasad and Sonawane (in press)
17	Genghda Thumbo	Banaskantha	23° 50' 00" N	71° 22' 00" E	Ajithprasad and Sonawane (in press)
18	Ghachi-no Bor	Mehsana	23° 36' 00" N	71° 53' 00" E	Bhan 1994
19	Gokhijadio-no Timbo	Mehsana	23° 37' 00" N	71° 52' 30" E	Bhan 1994
20	Gomsar-no Timbo	Surendranagar	23° 16' 20" N	71° 41' 25" E	Bhan 1994
21	Gordhaniya Timbo	Surendranagar	23° 28' 00" N	71° 54' 00" E	Ajithprasad and Sonawane (in press); Bhan 1994

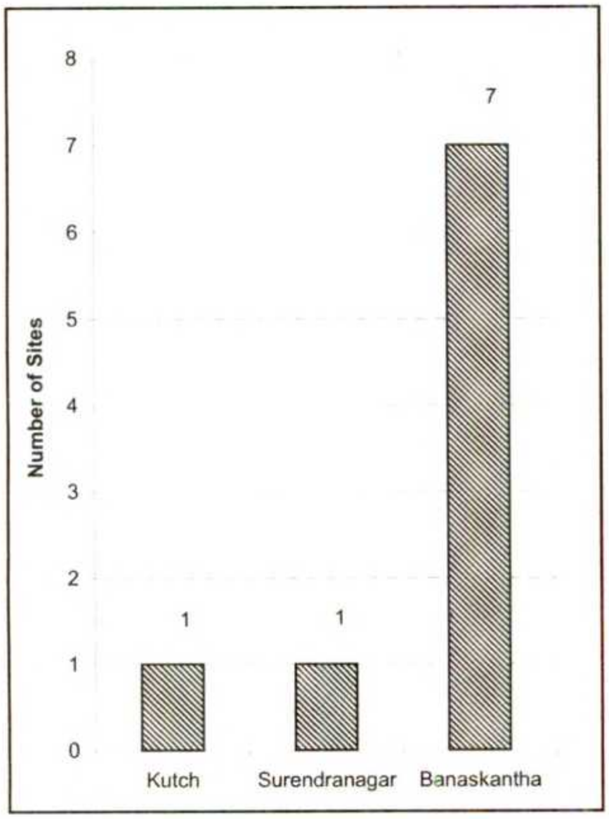

Fig. 8 District-wise distribution of Pre-Urban Harappan burial pottery sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
22	Hadka Walo Khetar (Datrana Four)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999
23	Haji no Kachha (Varanasi Two)	Banaskantha	23° 55' 00" N	71° 20' 00" E	Majumdar 1999
24	Harathamo Timbo	Mehsana	23° 25' 00" N	71° 48' 00" E	Bhan 1994
25	Harhari no Thumdo	Banaskantha	23° 53' 00" N	71° 27' 00" E	Majumdar 1999
26	Jakhra Pir no Thumdo (Suigam Two)	Banaskantha	24° 07' 00" N	71° 20' 00" E	Majumdar 1999
27	Jakhrapir-no Thumdo	Mehsana	24° 07' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
28	Javantri	Banaskantha	23° 54' 00" N	71° 33' 00" E	Ajithprasad and Sonawane (in press)
29	Jhandada-no Thumdo One	Banaskantha	23° 54' 20" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
30	Jhandada-no Thumdo Two	Banaskantha	23° 54' 10" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
31	Kalarino Timbo	Mehsana	23° 29' 00" N	71° 45' 20" E	Bhan 1994
32	Kalrio Timbo	Mehsana	23° 36' 60" N	71° 47' 00" E	Bhan 1994
33	Kanadia Thumdo	Rajkot	24° 01' 00" N	71° 28' 50" E	Ajithprasad and Sonawane (in press)
34	Kanakrialo Thumdo (Charandha Two)	Banaskantha	23° 60' 00" N	71° 30' 00" E	Majumdar 1999
35	Kathairyano Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
36	Khari-no Khetar	Banaskantha	23° 59' 10" N	71° 26' 00" E	Ajithprasad and Sonawane (in press)
37	Kuaward	Mehsana	23° 35' 00" N	71° 51' 00" E	Bhan 1994
38	Levana-no Godh	Banaskantha	23° 49' 00" N	71° 35' 00" E	Ajithprasad and Sonawane (in press)
39	Limbadka-no Thumdo	Banaskantha	23° 54' 00" N	71° 31' 00" E	Ajithprasad and Sonawane (in press)
40	Lolada	Mehsana	23° 33' 00" N	71° 41' 00" E	IAR 1978-79; Bhan 1994
41	Loteshwar (Khari no Timbo)	Mehsana	23° 36' 00" N	71° 50' 20" E	Hegde and Sonawane 1986; Bhan 1994
42	Manverpura	Mehsana	23° 35' 00" N	71° 53' 00" E	Bhan 1994
43	Mata-no Thumdo	Banaskantha	23° 59' 00" N	71° 26' 30" E	Ajithprasad and Sonawane (in press)
44	Mepla-no Thumdo	Banaskantha	23° 46' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
45	Mithghoda	Surendranagar	23° 17' 00" N	71° 43' 00" E	Bhan 1994
46	Moti Pipli	Banaskantha	23° 49' 00" N	71° 32' 00" E	Majumdar 1999 (Shakatri Timbo)
47	Nagwada Four	Surendranagar	23° 17' 20" N	71° 41' 30" E	IAR 1984-85; Bhan 1994
48	Nagwada One	Surendranagar	23° 18' 15" N	71° 42' 45" E	IAR 1984-85
49	Nani Chandur	Mehsana	23° 35' 00" N	71° 37' 30" E	Bhan 1994
50	Nayaka	Mehsana	23° 36' 50" N	71° 44' 00" E	Bhan 1994
51	Odherio Timbo (Loteshwar Two)	Mehsana	23° 36' 20" N	71° 49' 00" E	Bhan 1994
52	Ori-no Thumdo	Banaskantha	23° 50' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
53	Orumana	Mehsana	23° 36' 00" N	71° 53' 40" E	Bhan 1994

S.No.	Site Name	District/River	Latitude	Longitude	References
54	Padri	Bhavnagar	21° 20' 21" N	72° 06' 32" E	Shinde 1991; Shinde 1992
55	Panchasar	Mehsana	23° 25' 00" N	71° 48' 00" E	Bhan 1994
56	Patel-no Khetar	Banaskantha	23° 51' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
57	Ranol-no Timbo	Surendranagar	23° 23' 00" N	71° 38' 00" E	IAR 1984-85; Bhan 1994
58	Sankatrawalo Thumdo	Banaskantha	23° 54' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
59	Santhli no Thumdo (Santhli One)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
60	Santhli Three	Banaskantha	23° 53' 50" N	71° 29' 00" E	Ajithprasad and Sonawane (in press)
61	Sarwal	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
62	Shiharu-no Thumdo	Banaskantha	23° 50' 20" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
63	Soont-no Timbo	Banaskantha	23° 56' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
64	Surkotada	Kachchh	23° 37' 00" N	70° 50' 00" E	IAR 1964-65; Possehl 1980; 1999; Joshi *et al.* 1984
65	Thikariya-no Timbo	Mehsana	23° 31' 40" N	71° 45' 20" E	Joshi *et al.* 1984; Hegde and Sonawane 1986; Bhan 1994
66	Vanta no Thumdo (Datrana Ten)	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
67	Vatkiwalu Khetar I (Datrana Five)	Banaskantha	23° 46' 00" N	71° 06' 00" E	Majumdar 1999
68	Volda no Thumdo	Banaskantha	23° 51' 00" N	71° 20' 00" E	Majumdar 1999
69	Zekhada/Jekhda	Banaskantha	23° 51' 00" N	71° 28' 00" E	Momin 1983

Table 10: Urban Harappan (Classical/Sorath) sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
1	Adatala	Bhavnagar	21° 58' 05" N	71° 37' 06" E	Possehl 1980; 1999; Joshi *et al.* 1984
2	Adeva	Kheda	22° 36' 00" N	72° 33' 00" E	IAR 1972-73; Momin 1979
3	Adkot	Rajkot	22° 00' 00" N	71° 05' 00" E	IAR 1957-58; Ghosh 1989
4	Akhavadi no Timbo	Bhavnagar	22° 06' 00" N	72° 35' 00" E	(Goradka) Jairath 1986
5	Akru	Ahmedabad	22° 15' 00" N	71° 55' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
6	Akvada	Bhavnagar	-	-	IAR 1980-81
7	Alau	Ahmedabad	22° 15' 00" N	71° 30' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
8	Alav	-	-	-	Chitalwala 1985
9	Alia Bada	Jamnagar	22° 08' 00" N	69° 07' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1986

S.No.	Site Name	District/River	Latitude	Longitude	References
10	Ambaliala	Jamnagar	22° 12' 00" N	69° 44' 00" E	Joshi *et al.* 1984
11	Ambardi	-	-	-	Chitalwala 1985
12	Ambhliyar	Jamnagar	21° 59' 00" N	69° 42' 00" E	Bhan 1986
13	Ambliana	Jamnagar	-	-	IAR 1978-79
14	Amra	Jamnagar	22° 16' 00" N	69° 56' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
15	Aralee	Jamnagar	-	-	IAR 1980-81
16	Areeno no Timbo	Amreli	-	-	Possehl 1999
17	Arikhan One	Jamnagar	22° 05' 00" N	70° 01' 00" E	Bhan 1986
18	Atkot	Rajkot	22° 00' 00" N	71° 05' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
19	Atkot Bus Stand	Rajkot	22° 00' 42" N	71° 08' 46" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
20	Baba no Aohado	Surendranagar	22° 28' 30" N	71° 43' 55" E	Dimri 1999
21	Babarkot	Bhavnagar	22° 16' 04" N	71° 34' 15" E	IAR 1955-56; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
22	Babarkot Two	Surendranagar	22° 15' 00" N	71° 30' 00" E	Rao 1963; Ghosh 1989
23	Babra	Rajkot	-	-	IAR 1965-66
24	Bagasra (Gola Dhoro)	Rajkot	22° 50' 00" N	70° 41' 00" E	Sonawane *et al.* 2003; Bhan *et al.*2005

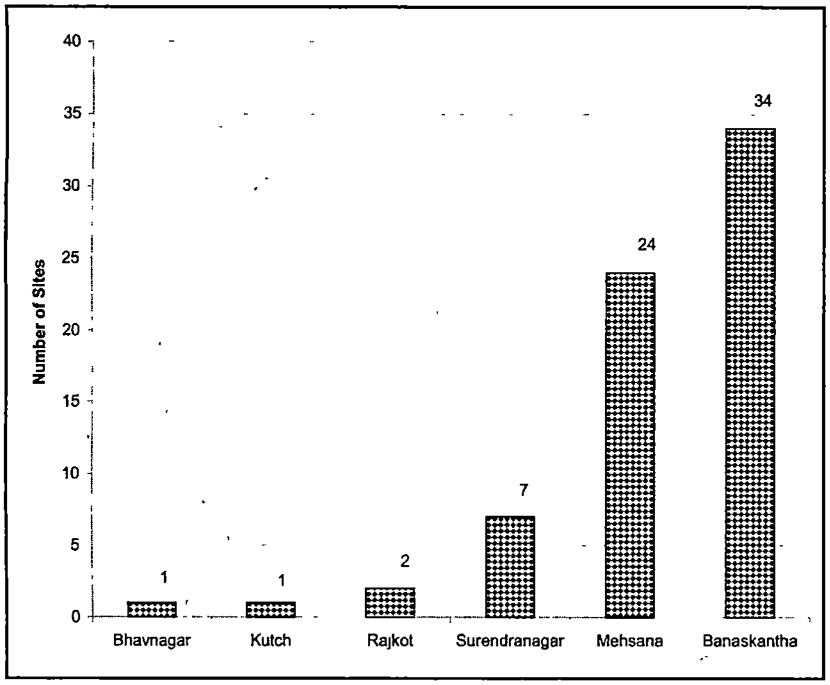

Fig. 9 District-wise distribution of Anarta Culture/Tradition sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	Reference
25	Balamba	Jamnagar	22° 40' 00" N	70° 20' 00" E	Bhan 1986
26	Balamdi	Jamnagar	22° 08' 00" N	70° 25' 00" E	Bhan 1986
27	Balbhai no Timbo	Mehsana	23° 27' 00" N	71° 46' 00" E	Majumdar 1999
28	Bava Khakaria One	Jamnagar	22° 14' 00" N	70° 24' 00" E	Bhan 1986
29	Bedi	Jamnagar	22° 27' 00" N	69° 57' 00" E	Bhan 1986
30	Belora	Rajkot	21° 47' 00" N	70° 46' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
31	Berajano Timbo	Jamnagar	22° 20' 00" N	69° 44' 00" E	Bhan 1986; Bhan 198
32	Bhachau	Kachchh	-	-	IAR 1985-86
33	Bhagatrav	Bharuch	21° 29' 00" N	72° 42' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
34	Bhagedi Mota	Jamnagar	-	-	Bhan 1983
35	Bhalgam	Rajkot	22° 02' 00" N	71° 05' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
36	Bhamakdal	Amreli	21° 45' 00" N	70° 50' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
37	Bhar no Timbo (Nasitpur)	Bhavnagar	22° 24' 00" N	71° 50' 00" E	Jairath 1986
38	Bhatiwadi	Amreli	21° 45' 00" N	70° 50' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
39	Bhatti-no Timbo (Bhadravadi)	Bhavnagar	22° 12' 00" N	71° 34' 00" E	Jairath 1986
40	Bhayakhakharia	Jamnagar	22° 10' 00" N	71° 50' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
41	Bhbhuro Dhoro	Amreli	-	-	Possehl; 1999
42	Bhimdad	Bhavnagar	22° 05' 00" N	71° 34' 00" E	Jairath 1986
43	Bhimnath	Ahmedabad	22° 15' 00" N	71° 55' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1986
44	Bhimpatal	Ahmedabad	22° 15' 00" N	71° 30' 00" E	IAR 1956-57; Rao 1963; Possehl 1980; 1999
45	Bhojavadar	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
46	Bhojavadar Three	Bhavnagar	21° 50' 59" N	71° 42' 49" E	Possehl 1980; 1999; Joshi *et al.* 1984
47	Bhokhardhar (Hadadad)	Bhavnagar	22° 08' 00" N	71° 34' 00" E	Jairath 1986
48	Bhoklidhar	Bhavnagar	21° 58' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
49	Bhut Kotada	Rajkot	22° 35' 00" N	70° 45' 00" E	Joshi *et al.* 1984
50	Bodaka	Jamnagar	22° 20' 00" N	70° 30' 00" E	Bhan 1986
51	Bodiono Dhoro	Amreli	21° 49' 00" N	71° 06' 00" E	Possehl 1999
52	Boria	Jamnagar	-	-	IAR 1980-81
53	Broach College	Bharuch	21° 48' 00" N	72° 58' 00" E	IAR 1969-70
54	Budhej	Kheda	22° 26' 00" N	72° 36' 00" E	IAR 1971-72; Momin 1979

S.No.	Site Name	District/River	Latitude	Longitude	References
55	Budhel	Bhavnagar	21° 45' 00" N	72° 09' 00" E	Possehl 1980; 1999; IAR 1980-81; Joshi *et al.* 1984
56	Chachana	Surendranagar	22° 25' 00" N	71° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
57	Chada-no-Timbo (Chada)	Bhavnagar	-	-	Bhan 1983
58	Changda	Kheda	22° 32' 00" N	72° 33' 00" E	IAR 1972-73:; IAR 1974-75; Momin 1979
59	Charanio	Bhavnagar	21° 52' 00" N	71° 38' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
60	Chashiana	Surendranagar	22° 25' 00" N	71° 50' 00" E	IAR 1954-55; Possehl 1980; 1999; Joshi *et al.* 1984
61	Chavaneshwar	Bharuch	21° 41' 00" N	72° 48' 00" E	IAR 1966-67; Possehl 1999; Joshi *et al.* 1984
62	Chhabasr	Ahmedabad	22° 46' 00" N	72° 16' 00" E	Joshi *et al.* 1984
63	Chitrod	Kachchh	23° 24' 00" N	70° 40' 00" E	IAR 1977-78; Joshi *et al.* 1984
64	Chosla	Bhavnagar	21° 53' 00" N	71° 34' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
65	Chravad One	Jamnagar	-	-	Bhan 1994
66	Cycle Factory Site (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
67	Dad	Rajkot	22° 50' 00" N	70° 55' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
68	Dantrad	-	-	-	Chitalwala 1985
69	Dared	-	-	-	Chitalwala 1985
70	Datrana Five	Banaskantha	23° 46' 15" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
71	Datrana Seven	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
72	Datrana Three	Banaskantha	23° 45' 50" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
73	Datrana Two	Banaskantha	23° 46' 00" N	71° 07' 10" E	Ajithprasad and Sonawane (in press)
74	Dehada	Kheda	22° 23' 00" N	72° 33' 00" E	Momin 1979
75	Desalpur	Kachchh	23° 37' 00" N	69° 08' 00" E	IAR 1955-56; Rao 1963; Possehl 1980; 1999
76	Deudhar	Rajkot	-	-	IAR 1957-58
77	Devalio	Surendranagar	22° 25' 00" N	71° 55' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
78	Devaliyo	Amreli	21° 52' 00" N	71° 25' 00" E	IAR 1955-56; Ghosh 1989
79	Devdhar	Rajkot	22° 07' 00" N	71° 09' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
80	Devganga	Ahmedabad	22° 18' 00" N	71° 50' 00" E	Joshi *et al.* 1984
81	Dhakhan Kunda noTimbo	Bhavnagar	22° 09' 00" N	71° 35' 00" E	Jairath 1986
82	Dhankanio	Amreli	21° 45' 00" N	70° 55' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
83	Dhankanio Two	Amreli	21° 47' 00" N	70° 55' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
84	Dholavira	Kachchh	23° 53' 10" N	70° 13' 00" E	IAR 1967-68; Possehl 1999; Joshi *et al.* 1984; Bisht 1989a; 1991
85	Dhrosan	Amreli	20° 50' 00" N	70° 40' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
86	Dhuapino	Amreli	21° 27' 00" N	71° 49' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
87	Dhudasia	Rajkot	-	-	IAR 1957-58
88	Dhulkhan (Moti Dharai)	Bhavnagar	21° 58' 00" N	71° 57' 00" E	Jairath 1986
89	Dhulkot	Jamnagar	20° 50' 00" N	71° 02' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
90	Dhulkot	Junagadh	22° 50' 00" N	71° 02' 00" E	Rao 1963; Ghosh 1989
91	Dhurasiano Timbo	Rajkot	-	-	Possehl 1999
92	Dhutarpur	Rajkot	21° 50' 00" N	71° 00' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
93	Dikwa no Khetar	Surendranagar	22° 40' 45" N	71° 55' 52" E	Dimri 1999
94	Dubhakia Mound (Chamardi)	Bhavnagar	21° 05' 00" N	71° 53' 00" E	Jairath 1986
95	Dudhala	Jamnagar	22° 14' 00" N	70° 17' 00" E	Bhan 1986
96	Dumiani	Rajkot	21° 45' 00" N	70° 20' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
97	Fala	Jamnagar	-	-	Chitalwala 1985
98	Fariyadka	Bhavnagar	-	-	IAR 1980-81
99	Gachi no Bor (Munjpur Two)	Mehsana	23° 36' 00" N	71° 53' 00" E	Majumdar 1999
100	Gadhada	Bhavnagar	21° 58' 20" N	71° 33' 45" E	Chitalwala 1985
101	Gadhada One	Rajkot	22° 26' 00" N	70° 36' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.*1984
102	Gadhada Three	Rajkot	22° 26' 00" N	70° 36' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.*1984
103	Gadhada Two	Rajkot	22° 26' 00" N	70° 36' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.*1984
104	Gadhadiya	Bhavnagar	22° 17' 00" N	71° 25' 00" E	Jairath 1986
105	Gadhali	Bhavnagar	21° 52' 00" N	71° 36' 00" E	Jairath 1986

S.No.	Site Name	District/River	Latitude	Longitude	References
106	Gadhwaliwadi	Kachchh	23° 30' 00" N	69° 08' 00" E	IAR 1976-77; IAR 1978-79; Joshi *et al.* 1984
107	Gadia	Jamnagar	22° 15' 00" N	70° 65' 00" E	Bhan 1989
108	Gamapipalia	-	-	-	Chitalwala 1985
109	Ganajadia no Timbo (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
110	Gandobhai no Timbo	Ahmedabad	22° 15' 54" N	71° 53' 14" E	Dimri 1999
111	Garani	-	-	-	Chitalwala 1985
112	Garasya no Thumdo (Charandha One)	Banaskantha	23° 60' 00" N	71° 30' 00" E	Majumdar 1999
113	Ghachi-no Bor	Mehsana	23° 36' 00" N	71° 53' 00" E	Bhan 1994
114	Ghelo Bund	Bhavnagar	21° 58' 00" N	71° 27' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
115	Ghelri-no Timbo (Anpur)	Bhavnagar	21° 52' 00" N	71° 55' 00" E	Jairath 1986
116	Ghoda Daman tank (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
117	Ghogralu no Timbo (Khijadiya)	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Jairath 1986
118	Ghorwada	Rajkot	21° 57' 00" N	71° 00' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
119	Godavari One	Jamnagar	22° 12' 00" N	69° 55' 00" E	Bhan 1989
120	Godha	Banaskantha	23° 36' 00" N	71° 28' 00" E	Bhan 1994
121	Godhapadar	Rajkot	22° 15' 00" N	71° 03' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999
122	Gomsar-no Timbo	Surendranagar	23° 16' 20" N	71° 41' 25" E	Bhan 1994
123	Goni Timbo	Surendranagar	22° 27' 00" N	71° 55' 00" E	IAR 1954-55; Possehl 1980; 1999; Joshi *et al.* 1984
124	Gop	Jamnagar	22° 01' 00" N	69° 56' 00" E	IAR 1953-54; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
125	Goriya	Jamnagar	-	-	IAR 1958-59
126	Gudel	Kheda	22° 44' 00" N	72° 31' 00" E	Momin 1979
127	Gunthai	Kachchh	23° 28' 00" N	69° 09' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
128	Hadiyana One	Jamnagar	23° 35' 00" N	70° 15' 00" E	Bhan 1989
129	Hadmatala	Ahmedabad	22° 30' 00" N	72° 08' 00" E	IAR 1978-79; Joshi *et al.* 1984
130	Haiduk no Thumdo Two (Dehisar Two)	Banaskantha	23° 56' 00" N	71° 31' 00" E	Majumdar 1999
131	Hajanbi	Rajkot	22° 50' 00" N	70° 35' 00" E	IAR 1959-60; Possehl 1980; 1999
132	Hanumanno Timbo	Bhavnagar	21° 57' 43" N	71° 34' 44" E	Possehl 1980; 1999; Joshi *et al.* 1984
133	Hariana	Jamnagar	22° 36' 00" N	70° 15' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
134	Hatangiri-no Timbo (Akvada)	Bhavnagar	21° 44' 00" N	72° 04' 00" E	Jairath 1986
135	Hathab	Bhavnagar	21° 35' 00" N	72° 15' 00" E	Jairath 1986
136	Hodthali	-	-	-	Chitalwala 1985
137	Holidhar (Lakhanka)	Bhavnagar	21° 58' 00" N	71° 38' 00" E	Jairath 1986
138	Indranagar-no Thumdo	Banaskantha	23° 53' 00" N	71° 35' 00" E	Ajithprasad and Sonawane (in press)
139	Indranj	Kheda	22° 30' 00" N	72° 33' 00" E	Momin 1979
140	Itaria	Bhavnagar	21° 58' 00" N	71° 27' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
141	Jafrabad	Kheda	22° 25' 00" N	72° 32' 00" E	Momin 1979
142	Jaidak/Pithad	Jamnagar	22° 40' 00" N	70° 35' 00" E	Rao 1963; IAR 1979-1980; Possehl 1999; Joshi *et al.* 1984
143	Jamathar-no Thumdo	Banaskantha	23° 45' 00" N	71° 14' 00" E	Ajithprasad and Sonawane (in press)
144	Jarwaliya	Ahmedabad	22° 14' 27" N	71° 55' 31" E	Dimri 1999
145	Jaska	Ahmedabad	22° 19' 10" N	71° 56' 10" E	Dimri 1999
146	Jasvantgadh	Amreli	-	-	Possehl 1999
147	Jatavadar	Kachchh	23° 45' 00" N	70° 40' 00" E	Joshi *et al.* 1984
148	Jawanpura	Panchmahals	-	-	IAR 1959-60
149	Jhakar	Jamnagar	-	-	Bhan 1983
150	Jhaloriano Tekro	Ahmedabad	-	-	IAR 1976-77
151	Jhangar; Anjar	Kachchh	23° 19' 10" N	70° 05' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984; Joshi 1990
152	Jhangar; Khavada	Kachchh	23° 53' 00" N	69° 44' 00" E	Chitalwala 1985
153	Jhanjmer	Rajkot	-	-	IAR 1957-58; Ghosh 1989
154	Jhikri	Rajkot	21° 55' 00" N	70° 50' 00" E	IAR 1959-60; Possehl 1980;1999; Joshi *et al.* 1984
155	Jinaj	Kheda	22° 24' 00" N	72° 36' 00" E	Momin 1979
156	Jivanino Dhoro	Bhavnagar	21° 50' 29" N	71° 45' 34" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.*1984
157	Jivapar	Jamnagar	22° 12' 00" N	70° 22' 00" E	Bhan 1989
158	Jodhpur	Rajkot	22° 40' 00" N	70° 53' 00" E	IAR 1980-81
159	Jonoyano Timbo	Surendranagar	23° 25' 00" N	71° 27' 00" E	Bhan 1994
160	Juna Babarkot (Paliyad)	Bhavnagar	22° 17' 00" N	71° 32' 00" E	Jairath 1986
161	Juna Chopadwa	Kachchh	23° 16' 00" N	70° 15' 00" E	IAR 1986-87
162	Juna Rampur	Bhavnagar	21° 52' 00" N	71° 50' 00" E	Jairath 1986
163	Juni Kuran	Kachchh	23° 27' 00" N	69° 47' 00" E	Pramanik 2003-04
164	Juni Timbo	Jamnagar	22° 09' 00" N	70° 22' 00" E	IAR 1980-81; Bhan 1989
165	Kaap-no-Timbo (Nana Paliyad)	Bhavnagar	22° 17' 00" N	71° 32' 00" E	Jairath 1986
166	Kaero Timbo	Surendranagar	22° 24' 00" N	71° 55' 00" E	IAR 1954-55; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
167	Kagvadar	-	-	-	Chitalwala 1985
168	Kaj	Amreli	20° 44' 00" N	70° 51' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
169	Kalapan	Rajkot	21° 55' 00" N	70° 20' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
170	Kalavad Four	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
171	Kalavad Three	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
172	Kalavad Two	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
173	Kalianpur	Jamnagar	21° 50' 00" N	69° 25' 00" E	Rao 1963; Possehl 1980;1999; Joshi *et al.* 1984
174	Kalibhai ni Vadi	Ahmedabad	22° 15' ‘ 54" N	71° 51' 19" E	Dimri 1999
175	Kalipat	Rajkot	-	-	IAR 1957-58; Possehl 1980; 1999
176	Kalrio Timbo	Mehsana	23° 36' 60" N	71° 47' 00" E	Bhan 1994
177	Kanadia Thumdo	Rajkot	24° 01' 00" N	71° 28' 50" E	Ajithprasad and Sonawane (in press)
178	Kanakrialo Thumdo (Charandha Two)	Banaskantha	23° 60' 00" N	71° 30' 00" E	Majumdar 1999
179	Kanewal; Keseri Sing no Timbo	Kheda	22° 28' 00" N	72° 30' 00" E	IAR 1972-73; 1974-75; 1977-78; Momin 1979; Mehta *et al.* 1980
180	Kanewal; Sai no Tekro	Kheda	22° 27' 00" N	72° 30' 00" E	IAR 1972-73; 1974-75; 1977-78; Momin 1979; Mehta *et al.* 1980
181	Kanjetar	Amreli	20° 45' 00" N	70° 40' 00" E	IAR 1956-57; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
182	Kanmer	Kachchh	-	-	IAR 1985-86
183	Kanthkot	Kachchh	23° 29' 00" N	70° 29' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
184	Karedia no Timbo	Ahmedabad	22° 19' 18" N	71° 42' 02" E	Dimri 1999
185	Karim Chika (Joliya)	Surendranagar	22° 28' 30" N	71° 43' 55" E	Dimri 1999
186	Karmalkota	Rajkot	21° 56' 01" N	71° 00' 09" E	Chitalwala 1985
187	Karmar	Rajkot	21° 50' 00" N	70° 53' 00" E	IAR 1977-78; Joshi *et al.* 1984
188	Kathairyano Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
189	Kerasi	Kachchh	23° 40' 00" N	70° 44' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984; Joshi 1990
190	Kerisimano Timbo	Kheda	22° 28' 00" N	72° 31' 00" E	Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
191	Keriya no Doro (Keriya)	Bhavnagar	-	-	Jairath 1986
192	Kerlavlo	Bhavnagar	21° 51' 24" N	71° 39' 32" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
193	Khadsaliya	Bhavnagar	21° 33' 00" N	72° 14' 00" E	Jairath 1986
194	Khakhara Bela One	Rajkot	22° 29' 00" N	70° 35' 00" E	IAR 1960-61
195	Khakhara Bela Three	Rajkot	22° 29' 00" N	70° 35' 00" E	IAR 1960-61; Possehl 1980; 1999
196	Khakhariya-no-Timbo (Juna Ishvariya)	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Jairath 1986
197	Khakhra Dera	Kachchh	23° 34' 00" N	70° 29' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
198	Khaksar	Kheda	22° 27' 00" N	72° 30' 00" E	Momin 1979
199	khambalano Dhoro	Amreli	-	-	Possehl 1999
200	Khambhodhar	Jamnagar	21° 45' 00" N	69° 35' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
201	Khandariya	Kachchh	-	-	IAR 1985-86
202	Khanderio One	Bhavnagar	21° 58' 00" N	71° 29' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
203	Khanderio Two	Bhavnagar	21° 58' 00" N	71° 30' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
204	Khanpur; Kaira	Kheda	22° 29' 00" N	72° 23' 00" E	IAR 1972-73; 1974-75; Momin1979
205	Khanpur; Rajkot	Rajkot	-	-	Possehl 1999
206	Khanpur; Surendranagar	Surendranagar	22° 32' 00" N	71° 58' 00" E	IAR 1962-63; Possehl 1980; 1999; Joshi *et al.* 1984
207	Kharedano Timbo	Rajkot	22° 05' 00" N	70° 48' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
208	Khari Timbo	Ahmedabad	22° 17' 45" N	71° 58' 50" E	Dimri 1999
209	Kharika khanda	Kachchh	23° 27' 00" N	70° 29' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984
210	Kharsaliya	Ahmedabad	22° 14' 27" N	71° 55' 31" E	Dimri 1999
211	Khaso Timbo	Mehsana	23° 25' 00" N	71° 45' 00" E	Bhan 1994
212	Khatariyo no Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
213	Khavda	Kachchh	-	-	IAR 1977-78
214	Khedoi	Kachchh	23° 03' 00" N	69° 57' 00" E	IAR 1970-71; 1976-77; Joshi *et al.* 1984
215	Kherio no Timbo (Kerala)	Bhavnagar	22° 02' 00" N	71° 29' 00" E	Jairath 1986
216	Kherio One (Rampara)	Bhavnagar	21° 58' 00" N	71° 30' 00" E	Jairath 1986
217	Kherio Two (Rampara)	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Jairath 1986
218	Khirasara	-	-	-	Chitalwala 1985
219	Khodiyar; Talaja	Bhavnagar	21° 24' 05" N	71° 59' 24" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
220	Khodiyar; Valabhipur	Bhavnagar	21° 58' 00" N	71° 57' 00" E	Possehl 1980; 1999
221	Khothawadi Timbo (Bhojavadar)	Bhavnagar	21° 52' 00" N	71° 42' 00" E	Jairath 1986
222	Kindarkhera	Junagadh	21° 48' 00" N	69° 33' 00" E	Rao 1963; Ghosh 1989
223	Kinner Kheda	Jamnagar	-	-	IAR 1955-56
224	Knee Bni na Karo (Pipli)	Bhavnagar	21° 52' 00" N	71° 50' 00" E	Jairath 1986
225	Kodir Mata no Timbo	Ahmedabad	22° 21' 25" N	71° 52' 30" E	Dimri 1999
226	Kota	Jamnagar	22° 10' 00" N	69° 42' 00" E	Joshi *et al.* 1984
227	Kotada Bhadli One	Kachchh	23° 22' 00" N	69° 26' 00" E	IAR 1965-66; Possehl 1980; 1995; Joshi *et al.* 1984
228	Kotada Bhadli Three	Kachchh	23° 22' 00" N	69° 26' 00" E	IAR 1965-66; Possehl 1980; 1999
229	Kotada Bhadli Two	Kachchh	23° 22' 00" N	69° 26' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984
230	Kotada; Jamnagar	Jamnagar	22° 12' 00" N	70° 22' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
231	Kotada; Kachchh	Kachchh	23° 18' 00" N	70° 06' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
232	Kotara	Kachchh	23° 58' 00" N	69° 47' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
233	Kotda	Jamnagar	23° 14' 00" N	70° 21' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
234	Koth	Ahmedabad	22° 38' 00" N	72° 18' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
235	Kothoda no Thumdo (Mathutra Three)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
236	Kundanpur	Rajkot	22° 05' 00" N	71° 10' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
237	Kuntasi	Rajkot	22° 50' 40" N	70° 37' 30" E	IAR 1977-78; IAR 1987-88; Dhavalikar *et al.* 1996
238	Kutharivad	Jamnagar	-	-	IAR 1980-81
239	Lakhabawal	Jamnagar	22° 24' 00" N	70° 00' 00" E	IAR 1955-56; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
240	Lakhan Timbo	Jamnagar	22° 29' 00" N	70° 36' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
241	Lakhanka	Bhavnagar	21° 48' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
242	Lakhapad	Ahmedabad	-	-	IAR 1978-79
243	Lakharia no Doro (Timbi)	Bhavnagar	21° 50' 00" N	71° 46' 00" E	Jairath 1986

S.No.	Site Name	District/River	Latitude	Longitude	References
244	Lakhasar One	Kachchh	23° 14' 00" N	70° 41' 00" E	IAR 1986-87
245	Lakhasar Two	Kachchh	23° 14' 00" N	70° 41' 00" E	IAR 1986-87
246	Lakhavan Lati	-	21° 51' 00" N	71° 27' 00" E	Possehl 1999
247	Lakhavarno Dhoro	Amreli	-	-	Possehl 1999
248	Lakhavav; Bhavnagar	Bhavnagar	21° 30' 00" N	71° 55' 00" E	Joshi *et al.* 1984
249	Lakhawad no Doro (Lakhawad)	Bhavnagar	-	-	Jairath 1986
250	Lakhawad-no-Timbo (Kaniyad)	Bhavnagar	22° 14' 00" N	71° 34' 00" E	Jairath 1986
251	Lakhpar/Lakhapur	Kachchh	23° 33' 00" N	70° 28' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984; Joshi 1990
252	Lakhpat	Kachchh	23° 50' 00" N	68° 47' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
253	Laloino Timbo	Jamnagar	22° 12' 00" N	70° 14' 00" E	IAR 1980-81; Bhan 1989
254	Langhnaj	Mehsana	23° 8' 00" N	72° 50' 00" E	Sankalia 1965; Ghosh 1989
255	Lihimo no Timbo	Surendranagar	22° 34' 20" N	71° 53' 10" E	Majumdar 1999
256	Limbavala Khetra	Mehsana	23° 32' 00" N	71° 46' 00" E	Dimri 1999
257	Limbdo no Khetar	Surendranagar	22° 27' 50" N	71° 51' 53" E	Majumdar 1999
258	Lolai	Jamnagar	22° 12' 00" N	70° 14' 00" E	Bhan 1986
259	Loliana	Bhavnagar	21° 54' 00" N	71° 48' 20" E	Momin 1979
260	Lothal	Ahmedabad	22° 31' 25" N	72° 14' 59" E	Rao 1963; 1976; 1985; Possehl 1999; Joshi *et al.* 1984
261	Lukhela	Rajkot	21° 50' 00" N	70° 00' 00" E	IAR 1958-59; Possehl 1999; Possehl 1980; 1999
262	Luna	Kachchh	23° 40' 00" N	69° 15' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
263	Luna Mandvi	Kachchh	22° 50' 00" N	69° 24' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
264	Machiala Mota	Amreli	21° 41' 00" N	71° 14' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
265	Madan Kundala Gondal	Rajkot	-	-	IAR 1983-84
266	Madeva	Amreli	21° 50' 00" N	71° 24' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
267	Mahadevio	Amreli	21° 54' 00" N	71° 17' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
268	Mahadevno Timbo	Amreli	-	-	Possehl 1999
269	Mahakalino Timbo	Ahmedabad	-	-	IAR 1976-77
270	Makansar	Rajkot	-	-	IAR 1957-58
271	Makvana	Bhavnagar	21° 57' 00" N	71° 40' 00" E	IAR 1960-61; Rao 1961; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
272	Malasaratalavdi	Ahmedabad	-	-	IAR 1974-75
273	Malgam	Rajkot	22° 01' 00" N	71° 26' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
274	Malgodh	Rajkot	22° 00' 00" N	70° 34' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
275	Maliyadar-no Timbo (Fariyadka)	Bhavnagar	21° 43' 00" N	72° 03' 00" E	Ghosh 1989
276	Malwan	Surat	21° 06' 00" N	72° 43' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
277	Manar	Bharuch	21° 42' 00" N	72° 47' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
278	Mandriyara Mohra	Kachchh	23° 30' 00" N	70° 16' 00" E	IAR 1986-87
279	Matewalno Tekro	Ahmedabad	-	-	IAR 1974-75
280	Mayo no Khado (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	IAR 1957-58; Ghosh 1989
281	Meghper	Kachchh	-	-	IAR 1980-81
282	Mehgam	Bharuch	21° 42' 00" N	72° 45' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
283	Melana Four	Bhavnagar	21° 55' 40" N	71° 46' 50" E	Possehl 1999
284	Mepla-no Thumdo	Banaskantha	23° 46' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
285	Metal Maha No Timbo	Ahmedabad	22° 47' 00" N	72° 14' 00" E	Joshi *et al.* 1984
286	Moda	Jamnagar	-	-	Majumdar 1999
287	Mora	Jamnagar	22° 28' 00" N	70° 14' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
288	Morvo	Kachchh	23° 50' 00" N	70° 42' 00" E	IAR 1967-68; Joshi 1972; Possehl 1980; 1999; Joshi *et al.* 1984
289	Mota Tarardia	Ahmedabad	22° 31' 50" N	71° 57' 52" E	Jairath 1986
290	Motachoprika	Ahmedabad	22° 21' 30" N	71° 48' 00" E	Possehl 1999
291	Mota-Khara (Langala)	Bhavnagar	21° 48' 00" N	71° 43' 00" E	IAR 1961-62; Ghosh 1989
292	Moti Gop	Jamnagar	22° 19' 00" N	69° 30' 00" E	Bhan 1986
293	Moti Pipli	Banaskantha	23° 49' 25" N	71° 31' 00" E	Bhan 1994
294	Motidharai	Bhavnagar	21° 57' 00" N	71° 54' 00" E	IAR 1955-56; 1957-58
295	Mulpadar; Kalianpar	Jamnagar	21° 56' 00" N	69° 45' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
296	Mulparda	Jamnagar	-	-	IAR 1979-80
297	Mulu	Kachchh	-	-	IAR 1979-80
298	Mungatoda	Jamnagar	-	-	IAR 1980-81
299	Murajpur	Ahmedabad	22° 24' 43" N	72° 56' 46" E	Dimri 1999
300	Nadiyara no Timbo	Ahmedabad	22° 28' 30" N	71° 57' 51" E	Dimri 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
301	Nageswar	Jamnagar	22° 18' 00" N	69° 02' 00" E	IAR 1980-81; 1983-84; Bhan 1986; Hegde *et al.* 1990
302	Nagwada Four	Surendranagar	23° 17' 20" N	71° 41' 30" E	IAR 1984-85; Bhan 1994
303	Nagwada One	Surendranagar	23° 18' 15" N	71° 42' 45" E	IAR 1984-85; Hegde *et al.* 1988
304	Nana Khara (Langala)	Bhavnagar	21° 48' 00" N	71° 43' 00" E	Jairath 1986
305	Nana Sapaka	Surendranagar	22° 21' 57" N	71° 35' 53" E	Dimri 1999
306	Nanichoprika	Ahmedabad	22° 22' 00" N	71° 46' 00" E	Possehl 1999
307	Nar	Kheda	22° 28' 00" N	72° 42' 00" E	IAR 1972-73; 1974-75; Momin 1979
308	Narapa	Kachchh	23° 29' 00" N	69° 09' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
309	Narmana One	Jamnagar	22° 15' 00" N	70° 09' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
310	Narmana Two	Jamnagar	-	-	Bhan 1983
311	Nashado	Surendranagar	22° 33' 30" N	71° 43' 50" E	Dimri 1999
312	Nashado One	Ahmedabad	22° 28' 30" N	71° 57' 51" E	Dimri 1999
313	Nashado Three	Ahmedabad	22° 20' 00" N	71° 54' 12" E	Dimri 1999
314	Nashado Two	Ahmedabad	22° 15' 00" N	71° 52' 12" E	Dimri 1999
315	Nasitpur	Bhavnagar	-	-	IAR 1980-81
316	Navagam	Surat	21° 16' 00" N	72° 56' 00" E	Joshi *et al.* 1984
317	Navagam (Gaekwad)	Bhavnagar	21° 55' 00" N	71° 53' 00" E	Jairath 1986
318	Navinal	Kachchh	22° 50' 00" N	69° 35' 00" E	Rao 1969; Possehl 1980; 1999; Joshi *et al.* 1984
319	Nenuni Dhar	Kachchh	23° 51' 00" N	69° 44' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
320	Ner	Kachchh	-	-	IAR 1980-81
321	Nesada (Tarasamia)	Bhavnagar	-	-	Jairath 1986
322	Nesadi (Valabhi)	Bhavnagar	21° 50' 00" N	71° 50' 00" E	Mehta 1984; Jairath 1986
323	Nesda (Nana Paliyad)	Bhavnagar	22° 10' 00" N	71° 31' 00" E	Jairath 1986
324	Nesda-no Timbo (Shervania)	Bhavnagar	22° 24' 00" N	71° 32' 00" E	Jairath 1986
325	Neshdo	Amreli	21° 53' 00" N	71° 23' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
326	Netra Khirasara	Kachchh	-	-	IAR 1969-70; 1976-77
327	Nikawa One	Jamnagar	22° 11' 00" N	70° 36' 00" E	Bhan 1986
328	Odee Ka Talia (Nasitpur)	Bhavnagar	22° 24' 00" N	71° 50' 00" E	Jairath 1986
329	Oliya Peer	Jamnagar	21° 16' 00" N	70° 01' 00" E	IAR 1980-81; Bhan 1983
330	Ood no Doro (Juna Ishvariya)	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Jairath 1986
331	Pabumath	Kachchh	23° 37' 00" N	70° 31' 40" E	IAR 1977-78; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
332	Padar	Rajkot	21° 59' 00" N	70° 50' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
333	Padar no Timbo (Khijadiya)	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Jairath 1986
334	Padra	Kheda	22° 28' 00" N	72° 33' 00" E	Momin 1979
335	Padri	Bhavnagar	21° 20' 21" N	72° 06' 32" E	Shinde 1992a; 1992b; Shinde and Kar 1992
336	Pagiyavalo no Thumdo (Mathutra Four)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
337	Pal	Rajkot	22° 18' 00" N	70° 43' 00" E	IAR 1964-65; Possehl 1980; 1999; Joshi *et al.* 1984
338	Palanpar no Timbo	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
339	Paliyad	Bhavnagar	22° 10' 00" N	71° 31' 00" E	Jairath 1986
340	Pancha Pipro	Jamnagar	22° 02' 00" N	70° 05' 00" E	IAR 1980-81; Bhan 1989
341	Panchpit	Ahmedabad	22° 22' 47" N	71° 52' 39" E	Dimri 1999
342	Pansina	Surendranagar	22° 31' 00" N	71° 55' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
343	Parieji	kheda	22° 32' 00" N	72° 37' 00" E	Momin 1979
344	Pasegam	Bhavnagar	21° 51' 14" N	71° 38' 48" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
345	Patana-no Timbo (Patana)	Bhavnagar	21° 51' 00" N	71° 32' 00" E	Jairath 1986
346	Patdi	Rajkot	-	-	IAR 1965-66
347	Pati no Timbo (Pati)	Bhavnagar	21° 51' 00" N	71° 51' 00" E	Jairath 1986
348	Pavatdhi (Patna)	Bhavnagar	-	-	Jairath 1986
349	Pavateswar Mahadev	Ahmedabad	22° 10' 00" N	71° 54' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
350	Peervala	Jamnagar	22° 05' 00" N	70° 01' 00" E	IAR 1980-81; Bhan 1989
351	Pepadia Timbo	Banaskantha	23° 50' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
352	Phala	Jamnagar	22° 18' 00" N	70° 32' 00" E	IAR 1954-55; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
353	Pingi no Timbo One	Ahmedabad	22° 19' 52" N	72° 00' 35" E	Dimri 1999
354	Pipalia	Rajkot	-	-	IAR 1980-81
355	Pipalia-no Dhoro (Sidsar)	Bhavnagar	21° 43' 00" N	72° 05' 00" E	Jairath 1986
356	Pipli	Bhavnagar	-	-	IAR 1980-81
357	Pirno Dhoro	Amreli	-	-	Possehl 1999
358	Pirwada Khetar	Kachchh	23° 20' 00" N	70° 00' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984
359	Pitar	Jamnagar	22° 41' 00" N	70° 32' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
360	Pitaria	Rajkot	21° 35' 00" N	70° 55' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
361	Pithad	Rajkot	21° 57' 00" N	70° 44' 00" E	IAR 1959-60; Joshi *et al.* 1984
362	Pithad One	Jamnagar	22° 41' 00" N	70° 32' 00" E	Bhan 1986
363	Pithadia; Jamnagar	Jamnagar	22° 24' 00" N	70° 29' 00" E	Bhan 1986
364	Pithavajal	-	-	-	Chitalwala 1985
365	Popatpura	Kheda	22° 35' 00" N	72° 32' 00" E	Momin 1979
366	Prabhas Patan (Somnath)	Junagadh	20° 53' 00" N	70° 24' 00" E	Nanavati *et al.*1971; Ghosh 1989
367	Rajathali	Rajkot	21° 55' 00" N	71° 01' 00" E	IAR 1957-58; Possehl 1980;1999; Joshi *et al.* 1984
368	Rajpipla Four	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
369	Rajpipla One	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
370	Rajpipla Six	Bhavnagar	21° 52' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
371	Rajpipla Three	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
372	Rajthali	Bhavnagar	21° 50' 00" N	71° 48' 00" E	Jairath 1986
373	Rakhodio Doro (Dharuka)	Bhavnagar	21° 49' 00" N	71° 52' 00" E	Jairath 1986
374	Rampar	-	-	-	Chitalwala 1985
375	Rampara	Kachchh	23° 30' 00" N	70° 45' 00" E	Joshi *et al.* 1984
376	Rampara One	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
377	Rampara Two	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
378	Ramvav	Kachchh	23° 32' 00" N	70° 28' 00" E	IAR 1977-78; Joshi *et al.* 1984
379	Randal Dadwa	Rajkot	-	-	IAR 1983-84
380	Randalio	Jamnagar	21° 49' 00" N	71° 03' 00" E	Rao 1963; Ghosh 1989
381	Randalio	Amreli	21° 48' 00" N	71° 03' 00" E	Rao 1963; Possehl 1980; 1999
382	Rangola	Bhavnagar	21° 47' 00" N	71° 38' 00" E	Jairath 1986
383	Rangpur	Surendranagar	22° 23' 56" N	71° 55' 19" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
384	Rangpur-no Timbo (Haliad)	Bhavnagar	21° 53' 00" N	71° 50' 00" E	Jairath 1986
385	Ranigam	Bhavnagar	21° 58' 00" N	71° 43' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
386	Raniono Timbo	Bhavnagar	-	-	IAR 1984-85
387	Ranol-no Timbo	Surendranagar	23° 23' 00" N	71° 38' 00" E	IAR 1984-85; Bhan 1994
388	Ranparda	Jamnagar	21° 55' 00" N	69° 23' 00" E	IAR 1957-58; Rao 1963; Bhan 1986
389	Ranpur	Jamnagar	-	-	IAR 1980-81

S.No.	Site Name	District/River	Latitude	Longitude	References
390	Rasnal	Jamnagar	22° 41' 00" N	70° 35' 00" E	IAR 1958-59; Bhan 1986
391	Rasnalia-no Timbo (Patana)	Bhavnagar	21° 51' 00" N	71° 32' 00" E	Jairath 1986
392	Rel	Kheda	22° 28' 00" N	72° 30' 00" E	IAR 1972-73; Momin 1979
393	Rhalia no Timbo	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
394	Rohiodas no Timbo	Bhavnagar	21° 55' 00" N	71° 53' 00" E	Jairath 1986
395	Rojasar	Ahmedabad	22° 21' 32" N	72° 02' 12" E	Dimri 1999
396	Rojdi	Rajkot	21° 51' 47" N	70° 55' 08" E	IAR 1957-58; Rao 1963; Possehl and Rawal 1989; Possehl 1999
397	Rupamore	Jamnagar	21° 60' 00" N	69° 45' 00" E	IAR 1978-79; Bhan 1986
398	Rupavati	Surendranagar	22° 43' 50" N	71° 58' 20" E	Dimri 1999
399	Rupavati Doro (Piparali)	Bhavnagar	21° 40' 00" N	71° 45' 00" E	Jairath 1986
400	Saaheer no Timbo (Bhadi)	Bhavnagar	-	-	Jairath 1986
401	Sai Devaliya	Jamnagar	-	-	Bhan 1983
402	Sai no Tekro	Kheda	22° 28' 00" N	72° 31' 00" E	Joshi *et al.* 1984
403	Samadhi Timbo (Samadhiala)	Bhavnagar	21° 52' 00" N	71° 41' 00" E	Jairath 1986
404	Samadhiala	Bhavnagar	21° 52' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
405	Samadhiala	Surendranagar	22° 19' 00" N	71° 42' 00" E	Possehl 1980 Possehl 1999; Joshi *et al.* 1984
406	Samagogha	Kachchh	22° 55' 00" N	69° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
407	Sanara Timbo	Jamnagar	-	-	IAR 1978-79
408	Sapara	Kachchh	-	-	IAR 1979-80
409	Saparwadi	Jamnagar	-	-	IAR 1980-81
410	Sarwania	Jamnagar	22° 09' 00" N	70° 22' 00" E	Bhan 1986
411	Saudevalio	Jamnagar	22° 00' 00" N	69° 44' 00" E	Joshi *et al.* 1984
412	Savani	Jamnagar	20° 58' 00" N	70° 28' 00" E	IAR 1977-78; Joshi *et al.* 1984
413	Sayra	-	-	-	Chitalwala 1985
414	Seed Farm	Bhavnagar	20° 57' 52" N	71° 35' 15" E	Possehl 1980; 1999; Joshi *et al.* 1984
415	Selari	Kachchh	23° 42' 00" N	70° 37' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
416	Shakatri Timbo	Banaskantha	23° 49' 00" N	71° 32' 00" E	Majumdar 1999
417	Sheikpur	Surendranagar	22° 21' 57" N	71° 45' 53" E	Dimri 1999
418	Shikarpur	Kachchh	23° 07' 00" N	70° 35' 00" E	IAR 1986-87
419	Shrinagar	Jamnagar	21° 39' 00" N	69° 37' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
420	Shrinagar	Junagadh	21° 35' 00" N	69° 34' 00" E	Rao 1963; Ghosh 1989
421	Sidsar	Bhavnagar	-	-	IAR 1980-81
422	Sihor	Bhavnagar	21° 43' 00" N	72° 00' 00" E	Jairath 1986
423	Singeh	Jamnagar	-	-	Bhan 1983

S.No.	Site Name	District/River	Latitude	Longitude	References
424	Siyanagar	Bhavnagar	22° 02' 00" N	71° 41' 00" E	Jairath 1986
425	Sonaria	Jamnagar	22° 00' 00" N	69° 46' 00" E	Bhan 1988
426	Surkotada	Kachchh	23° 37' 00" N	70° 50' 00" E	IAR 1964-65; Possehl 1980; 1999; Joshi 1972; 1990; Joshi *et al.* 1984
427	Suryavadar One	Jamnagar	21° 56' 00" N	69° 45' 00" E	Bhan 1986
428	Talwandi no Ṭimbo	Ahmedabad	22° 45' 00" N	72° 20' 00" E	Joshi *et al.* 1984
429	Tankaria	Jamnagar	21° 56' 00" N	69° 25' 00" E	IAR 1979-80; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
430	Taraghada	Rajkot	21° 44' 00" N	70° 26' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
431	Taragraha	Bhavnagar	-	-	Jairath 1986
432	Tarana Four	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1979-80; Bhan 1989
433	Tarana One	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1979-80
434	Tarana Three	Jamnagar	22° 43' 00" N	70° 27' 00" E	Bhan 1989
435	Tarana Two	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
436	Tarasamra	Bhavnagar	-	-	IAR 1980-81
437	Tarshikhad	Ahmedabad	-	-	IAR 1974-75
438	Tatam	Bhavnagar	22° 04' 00" N	71° 36' 00" E	Jairath 1986
439	Tatana	Bhavnagar	21° 58' 00" N	71° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
440	Telod	Bharuch	21° 42' 00" N	72° 46' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
441	Tetariyo	Amreli	21° 49' 00" N	71° 06' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
442	Thapnath (Chogath)	Bhavnagar	21° 50' 00" N	71° 50' 00" E	Jairath 1986
443	Thumba	Banaskantha	-	-	Bhan 1994
444	Thumda One	Mehsana	-	-	Bhan 1994
445	Timaram	Rajkot	21° 53' 00" N	70° 30' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
446	Timbi One	Jamnagar	-	-	IAR 1980-81
447	Timbo	Ahmedabad	22° 20' 50" N	71° 49' 51" E	Dimri 1999
448	Timbo One	Ahmedabad	22° 18' 03" N	71° 48' ‘ 23" E	Dimri 1999
449	Ṭimbo Two	Ahmedabad	22° 19' 52" N	72° 00' 35" E	Majumdar 1999
450	Todio	Kachchh	23° 05' 00" N	68° 55' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
451	Ubhad	Surat	-	-	IAR 1982-83

S.No.	Site Name	District/River	Latitude	Longitude	References
452	Ujalvav-no-Timbo (Ujalvav)	Bhavnagar	22° 03' 00" N	71° 53' 00" E	Jairath 1986
453	Una	Jamnagar	-	-	IAR 1956-57
454	Vada	Kachchh	23° 29' 00" N	69° 07' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
455	Vadadi no Timbo	Mehsana	23° 35' 00" N	71° 53' 00" E	Majumdar 1999
456	Vadasada	Rajkot	21° 47' 00" N	70° 45' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
457	Vadera	Amreli	21° 36' 00" N	71° 06' 00" E	IAR 1978-79; Joshi *et al.* 1984
458	Vadgam	Kheda	22° 19' 00" N	72° 28' 00" E	IAR 1964-65; Joshi *et al.* 1984
459	Vadi Talavadi no Thumdo	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
460	Vadli	Rajkot	-	-	Possehl 1999
461	Vagad	Ahmedabad	22° 19' 00" N	71° 52' 00" E	Mehta and Sonawane 1985
462	Vaghatalav	Kheda	22° 32' 00" N	72° 27' 00" E	Momin 1979
463	Vagrano Dhoro	Amreli	-	-	Possehl 1999
464	Vaharvo	Bhavnagar	21° 50' 50" N	71° 43' 55" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
465	Vaidwali Mohra	Kachchh	-	-	IAR 1985-86
466	Valabhi	Bhavnagar	21° 53' 00" N	71° 53' 00" E	IAR 1979-80; Mehta 1982
467	Valabhipur	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
468	Vala-no Timbo (Karala)	Bhavnagar	21° 59' 00" N	71° 29' 00" E	Jairath 1986
469	Valbai-no Timbo (Turkha)	Bhavnagar	22° 08' 00" N	71° 32' 00" E	Jairath 1986
470	Valotri	Kheda	22° 32' 00" N	72° 35' 00" E	IAR 1972-73; 1974-75
471	Valpura	Bhavnagar	21° 57' 00" N	71° 42' 00" E	Joshi *et al.* 1984
472	Vanali no Timbo (Vanali)	Bhavnagar	21° 54' 00" N	71° 35' 00" E	Jairath 1986
473	Vaniavadar	Amreli	21° 39' 00" N	71° 09' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
474	Vankiner	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1979-80; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
475	Vanta no Thumdo (Datrana Ten)	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
476	Vanta Vash	Surendranagar	-	-	IAR 1979-80
477	Varudimatano Timbo	Ahmedabad	-	-	IAR 1976-77
478	Varwala	Jamnagar	-	-	IAR 1979-80
479	Vasai	Jamnagar	22° 24' 00" N	70° 00' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1983; Joshi *et al.* 1984
480	Vasavad	-	-	-	Chitalwala 1985
481	Vegadi	Rajkot	21° 47' 00" N	70° 30' 00" E	IAR 1958-59; Possehl 1980; 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
482	Vernatha	Mehsana	23° 38' 00" N	71° 54' 00" E	Bhan 1994
483	Vhali-no Timbo (Bhadravadi)	Bhavnagar	22° 13' 00" N	71° 33' 00" E	Jairath 1986
484	Vikrarambhai no Timbo	Ahmedabad	22° 18' 20" N	72° 01' 02" E	Dimri 1999
485	Virpur; Gondal	Rajkot	-	-	Chitalwala 1985
486	Virpur; Jamnagar	Jamnagar	22° 07' 00" N	70° 56' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1983; Joshi *et al.* 1984
487	Virpur-no Timbo (Haripar)	Bhavnagar	21° 59' 00" N	71° 32' 00" E	Jairath 1986
488	Volda no Thumdo	Banaskantha	23° 51' 00" N	71° 20' 00" E	Majumdar 1999
489	Zekhada/Jekhda	Banaskantha	23° 51' 00" N	71° 28' 00" E	Mehta 1982
490	Zinawari	Jamnagar	-	-	Bhan 1983

Table 11: Post-Urban Harappan sites in Gujarat

S.No.	Site	District	Latitude	Longitude	References
1	Adatala	Bhavnagar	21° 58' 05" N	71° 37' 06" E	Possehl 1980; 1999; Joshi *et al.* 1984
2	Adkot	Rajkot	22° 00' 00" N	71° 05' 00" E	IAR 1957-58; Ghosh 1989
3	Ajamer	Rajkot	22° 40' 00" N	70° 50' 00" E	Ghosh 1989
4	Akru	Ahmedabad	22° 15' 00" N	71° 55' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
5	Alatala	Bhavnagar	-	-	IAR 1960-61; Ghosh 1989
6	Alau	Ahmedabad	22° 15' 00" N	71° 30' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
7	Alia Bada	Jamnagar	22° 08' 00" N	69° 07' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1986
8	Ambaradi	Rajkot	-	-	IAR 1978-79
9	Ambhliyar	Jamnagar	21° 59' 00" N	69° 42' 00" E	Bhan 1986
10	Amra	Jamnagar	22° 16' 00" N	69° 56' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
11	Andhi	Surat	21° 23' 00" N	72° 47' 00" E	IAR 1961-62
12	Ardoi	Rajkot	22° 05' 00" N	70° 47' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
13	Areenono Timbo	Amreli	-	-	Possehl 1999
14	Arikhan One	Jamnagar	22° 05' 00" N	70° 01' 00" E	Bhan 1986
15	Atariyano Timbo	Mehsana	23° 39' 30" N	71° 55' 30" E	IAR 1982-83; Hegde and Sonawane 1986; Bhan 1994

S.No.	Site Name	District/River	Latitude	Longitude	References
16	Atkot Bus Stand	Rajkot	22° 00' 42" N	71° 08' 46" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
17	Babarkot	Bhavnagar	22° 16' 04" N	71° 34' 15" E	IAR 1955-56; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
18	Babarkot Two	Surendranagar	22° 15' 00" N	71° 30' 00" E	Rao 1963; Ghosh 1989
19	Bagasra (Gola Dhoro)	Rajkot	22° 50' 00" N	70° 41' 00" E	Sonawane *et al.* 2003; Bhan *et al.*2005
20	Bagaya-no-Timbo	Mehsana	23° 25' 30" N	71° 49' 30" E	Hegde and Sonawane 1986; Bhan 1994
21	Balamba	Jamnagar	22° 40' 00" N	70° 20' 00" E	Bhan 1986
22	Balamdi	Jamnagar	22° 08' 00" N	70° 25' 00" E	Bhan 1986
23	Bareja	Ahmedabad	22° 27' 20" N	71° 58' 20" E	Dimri 1999
24	Bava Khakaria One	Jamnagar	22° 14' 00" N	70° 24' 00" E	Bhan 1986
25	Bed	Jamnagar	22° 26' 00" N	69° 57' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
26	Bedi	Jamnagar	22° 27' 00" N	69° 57' 00" E	Bhan 1986
27	Belora	Rajkot	21° 47' 00" N	70° 46' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

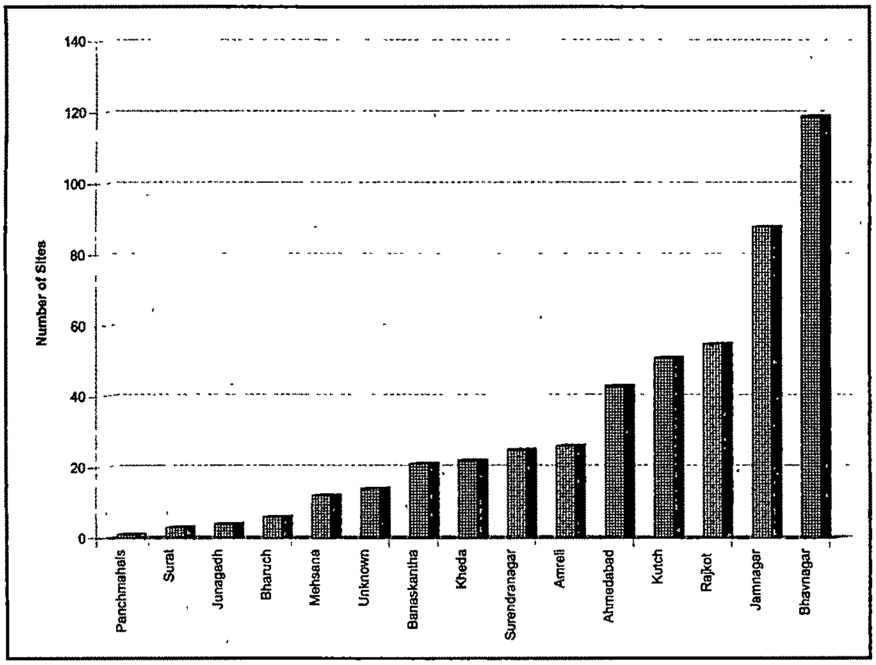

Fig. 10 District-wise distribution of Urban Harappan (Classical/Sorath) sites in Gujarat

S.No.	Site Name	District/River	Latitude	Longitude	References
28	Berajano Timbo	Jamnagar	22° 20' 00" N	69° 44' 00" E	Bhan 1986; Bhan 1989
29	Bet Dwarka/ Beyt Dwaraka	Jamnagar	22° 20' 00" N	69° 05' 00" E	Gaur and Sundaresh 2003
30	Bhagatrav	Bharuch	21° 29' 00" N	72° 42' 00" E	IAR 1957-58; Rao 1963 ; Possehl 1980; 1999; Joshi *et al.* 1984
31	Bhagedi Mota	Jamnagar	-	-	Bhan 1983
32	Bhalbhai-no Timbo	Mehsana	23° 27' 00" N	71° 46' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1994
33	Bhamaria Thumdo	Banaskantha	23° 54' 00" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
34	Bhangor	Jamnagar	22° 05' 00" N	69° 22' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
35	Bhatiwadi	Amreli	21° 45' 00" N	70° 50' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
36	Bhavgan Sadur	Surendranagar	22° 33' 40" N	71° 50' 55" E	Dimri 1999
37	Bhbhuro Dhoro	Amreli	-	-	Possehl; 1999
38	Bhimpatal	Ahmedabad	22° 15' 00" N	71° 30' 00" E	IAR 1956-57; Rao 1963; Possehl 1980; Possehl 1999
39	Bhojavadar Three	Bhavnagar	21° 50' 59" N	71° 42' 49" E	Possehl 1980; 1999; Joshi *et al.* 1984
40	Bhokhardhar (Hadadad)	Bhavnagar	22° 08' 00" N	71° 34' 00" E	Jairath 1986
41	Bhoklidhar	Bhavnagar	21° 58' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
42	Bhumlani	Surendranagar	22° 33' 00" N	71° 40' 20" E	Dimri 1999
43	Bhutawed no Godh	Banaskantha	23° 51' 00" N	71° 23' 00" E	Ajithprasad and Sonawane (in press)
44	Binanagari	Jamnagar	22° 43' 00" N	70° 22' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
45	Bodaka	Jamnagar	22° 20' 00" N	70° 30' 00" E	Bhan 1986
46	Bodio no Dhoro	Amreli	21° 49' 00" N	71° 06' 00" E	Possehl 1999
47	Bokhira	Porbandar	21° 39' 20" N	69° 36' 10" E	Gaur *et al.* 2006
48	Borawalo Khetar	Mehsana	23° 42' 00" N	71° 51' 00" E	IAR 1982-83; Hegde and Sonawane 1986; Bhan 1994
49	Bordanu	Surendranagar	22° 32' 00" N	71° 42' 00" E	Dimri 1999
50	Broach College	Bharuch	21° 48' 00" N	72° 58' 00" E	IAR 1969-70
51	Budhel	Bhavnagar	21° 45' 00" N	72° 09' 00" E	Possehl 1980; 1999; IAR 1980-81; Joshi *et al.* 1984
52	Chachana	Surendranagar	22° 25' 00" N	71° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
53	Chandrawara One	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1957-58; Possehl 1980; 1999; Bhan 1986
54	Chandrawara Two	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1957-58; Possehl 1980; 1999; Bhan 1986
55	Chanidhar	Jamnagar	22° 16' 00" N	70° 01' 00" E	Bhan 1983
56	Chaniyathar No Timbo	Banaskantha	23° 31' 00" N	71° 44' 00" E	Bhan 1994
57	Charanio	Bhavnagar	21° 52' 00" N	71° 38' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
58	Chavaneshwar	Bharuch	21° 41' 00" N	72° 48' 00" E	IAR 1966-67; Possehl 1999; Joshi *et al.* 1984
59	Chipa-no Godh	Banaskantha	23° 45' 00" N	71° 16' 30" E	Ajithprasad and Sonawane (in press)
60	Chosla	Bhavnagar	21° 53' 00" N	71° 34' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
61	Chota Isvaria	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
62	Chravad One	Jamnagar	-	-	Bhan 1994
63	Cycle Factory Site (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	Jairath 1986
64	Daidungri	Rajkot	22° 00' 00" N	71° 05' 00" E	Rao 1963; Possehi 1980; Joshi *et al.* 1984
65	Dared Two	Bhavnagar	21° 58' 00" N	71° 46' 00" E	Possehl 1999
66	Datrana Five	Banaskantha	23° 46' 15" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
67	Datrana One	Banaskantha	23° 46' 10" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
68	Datrana Seven	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
69	Datrana Three	Banaskantha	23° 45' 50" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
70	Datrana Two	Banaskantha	23° 46' 00" N	71° 07' 10" E	Ajithprasad and Sonawane (in press)
71	Deriwalo khetar One	Mehsana	23° 30' 20" N	71° 55' 30" E	Joshi *et al.* 1984; Bhan 1994
72	Devalio	Amreli	21° 53' 00" N	71° 23' 00" E	IAR 1955-56; Possehl 1980; 1999; Joshi *et al.* 1984
73	Devaliyo	Amreli	21° 52' 00" N	71° 25' 00" E	IAR 1955-56; Ghosh 1989
74	Devalkano Doro	Rajkot	-	-	Possehl 1999
75	Devdhar	Rajkot	22° 07' 00" N	71° 09' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
76	Dhama	Surendranagar	23° 23' 00" N	71° 39' 00" E	Bhan 1994
77	Dharovadno Timbo	Surendranagar	23° 23' 30" N	71° 48' 00" E	IAR 1984-85; Bhan 1994

S.No.	Site Name	District/River	Latitude	Longitude	References
78	Dhatva	Surat	21° 09' 00" N	72° 46' 00" E	Mehta and Chaudhary 1975; Bhan 1989
79	Dholavira	Kachchh	23° 53' 10" N	70° 13' 00" E	IAR 1967-68; Possehl 1999; Joshi *et al.* 1984; Bisht 1989; 1991
80	Dhoraji	Rajkot	-	-	IAR 1978-79
81	Dhrufaniya	Rajkot	-	-	IAR 1982-83
82	Dhulkot	Jamnagar	20° 50' 00" N	71° 02' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
83	Dhulkot	Junagadh	22° 50' 00" N	71° 02' 00" E	Rao 1963; Ghosh 1989
84	Dhurasiano Timbo	Rajkot	-	-	Possehl 1999
85	Duderia Timbo (Panchasar Two)	Mehsana	23° 25' 00" N	71° 48' 00" E	Majumdar 1999
86	Dudhala	Jamnagar	22° 14' 00" N	70° 17' 00" E	Bhan 1986
87	Dungarpur	Rajkot	22° 03' 00" N	71° 31' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
88	Dwarka	Jamnagar	22° 13' 00" N	69° 00' 00" E	IAR 1979-80; Bhan 1989
89	Gadhiyano Timbo	Mehsana	23° 31' 00" N	71° 53' 00" E	Joshi *et al.* 1984; Bhan 1989
90	Gadia	Jamnagar	22° 15' 00" N	70° 65' 00" E	Bhan 1989
91	Gameri	Kachchh	-	-	IAR 1985-86
92	Garasya no Thumdo (Charandha One)	Banaskantha	23° 60' 00" N	71° 30' 00" E	Majumdar 1999
93	Genghda Thumbo	Banaskantha	23° 50' 00" N	71° 22' 00" E	Ajithprasad and Sonawane (in press)
94	Ghelo Bund	Bhavnagar	21° 58' 00" N	71° 27' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
95	Ghorwada	Rajkot	21° 57' 00" N	71° 00' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
96	Godavari One	Jamnagar	22° 12' 00" N	69° 55' 00" E	Bhan 1989
97	Godha	Mehsana	23° 40' 00" N	71° 36' 00" E	Bhan 1994
98	Godha	Banaskantha	23° 36' 00" N	71° 28' 00" E	Bhan 1994
99	Godhapadar	Rajkot	22° 15' 00" N	71° 03' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; Possehl 1999
100	Godhiya-no Timbo	Mehsana	23° 30' 10" N	71° 53' 30" E	Ajithprasad and Sonawane (in press)
101	Gomsar-no Timbo	Surendranagar	23° 16' 20" N	71° 41' 25" E	Bhan 1994
102	Gop	Jamnagar	22° 01' 00" N	69° 56' 00" E	IAR 1953-54; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
103	Gordhaniya Timbo	Surendranagar	23° 28' 00" N	71° 54' 00" E	Ajithprasad and Sonawane (in press); Bhan 1994
104	Gorivata no Timbo (Bolera One)	Mehsana	23° 29' 00" N	71° 50' 00" E	Majumdar 1999
105	Goriya	Jamnagar	-	-	IAR 1958-59
106	Hadiyana One	Jamnagar	23° 35' 00" N	70° 15' 00" E	Bhan 1989
107	Hanumanno Timbo	Bhavnagar	21° 57' 43" N	71° 34' 44" E	Possehl 1980; 1999; Joshi *et al.* 1984
108	Harhari no Thumdo	Banaskantha	23° 53' 00" N	71° 27' 00" E	Majumdar 1999
109	Haripur One	Jamnagar	22° 16' 00" N	70° 01' 00" E	Bhan 1986
110	Harthar-no Timbo	Mehsana	23° 26' 00" N	71° 49' 00" E	Hegde and Sonawane 1986; Bhan 1994
111	Hasanpur	Surat	21° 25' 00" N	72° 46' 00" E	Joshi *et al.* 1984
112	Hasanpur	Bharuch	-	-	Rao 1963; Ghosh 1989
113	Hatangiri-no Timbo (Akvada)	Bhavnagar	21° 44' 00" N	72° 04' 00" E	Jairath 1986
114	Hemadra	Rajkot	-	-	Possehl 1999
115	Holivalo	Bhavnagar	21° 57' 00" N	71° 40' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
116	Inderwa-no Timbo One	Banaskantha	24° 01' 10" N	71° 28' 00" E	Ajithprasad and Sonawane (in press)
117	Inderwa-no Timbo Two	Banaskantha	24° 01' 10" N	71° 29' 00" E	Ajithprasad and Sonawane (in press)
118	Indranagar-no Thumdo	Banaskantha	23° 53' 00" N	71° 35' 00" E	Ajithprasad and Sonawane (in press)
119	Indranj	Kheda	22° 30' 00" N	72° 33' 00" E	Momin 1979
120	Ishwar Godh	Banaskantha	23° 46' 00" N	71° 18' 00" E	Ajithprasad and Sonawane (in press)
121	Isvaria	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Joshi *et al.* 1984
122	Itaria	Bhavnagar	21° 58' 00" N	71° 27' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
123	Jagaroh	Kachchh	23° 21' 00" N	70° 11' 00" E	IAR 1986-87
124	Jagtapir no Dhoro	Rajkot	-	-	Possehl 1999
125	Jaidak/Pithad	Jamnagar	22° 40' 00" N	70° 35' 00" E	Rao 1963; IAR 1979-1980; Possehl 1999; Joshi *et al.* 1984
126	Jakhrapir-no Thumdo	Mehsana	24° 07' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
127	Jamathar-no Thumdo	Banaskantha	23° 45' 00" N	71° 14' 00" E	Ajithprasad and Sonawane (in press)
128	Janoya-no Timbo	Surendranagar	23° 25' 00" N	71° 51' 20" E	Hegde and Sonawane 1986; Bhan 1994
129	Jarwaliya	Ahmedabad	22° 14' 27" N	71° 55' 31" E	Dimri 1999
130	Jasapar	Jamnagar	22° 12' 00" N	70° 25' 00" E	Bhan 1986
131	Jasvantgadh	Amreli	-	-	Possehl 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
132	Javantri	Banaskantha	23° 54' 00" N	71° 33' 00" E	Ajithprasad and Sonawane (in press)
133	Jawanpura	Panchmahals	-	-	IAR 1959-60
134	Jhakar	Jamnagar	-	-	Bhan 1983
135	Jhandada-no Thumdo One	Banaskantha	23° 54' 20" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
136	Jhandada-no Thumdo Two	Banaskantha	23° 54' 10" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
137	Jhanjmer	Rajkot	-	-	IAR 1957-58; Ghosh 1989
138	Jivanino Dhoro	Bhavnagar	21° 50' 29" N	71° 45' 34" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
139	Jivapar	Jamnagar	22° 12' 00" N	70° 22' 00" E	Bhan 1989
140	Jokha	Surat	21° 17' 00" N	73° 00' 00" E	IAR 1966-67; Mehta and Chaudhary 1971
141	Jorubhai no Timbo	Ahmedabad	22° 18' 20" N	72° 01' 02" E	Dimri 1999
142	Kaap-no-Timbo (Nana Paliyad)	Bhavnagar	22° 17' 00" N	71° 32' 00" E	Jairath 1986
143	Kachcha-no Thumdo	Banaskantha	23° 53' 00" N	71° 24' 30" E	Ajithprasad and Sonawane (in press)
144	Kacho Timbo	Mehsana	23° 25' 00" N	71° 45' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1984
145	Kalapan	Rajkot	21° 55' 00" N	70° 20' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
146	Kalarino Timbo	Mehsana	23° 30' 10" N	71° 45' 00" E	Hegde and Sonawane 1986; Bhan 1994
147	Kalatalawadi no Thumdo (Santhli Five)	Banaskantha	23° 54' 00" N	71° 29' 00" E	Majumdar 1999
148	Kalavad Four	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
149	Kalavad Three	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
150	Kalavad Two	Jamnagar	22° 12' 00" N	70° 22' 00" E	IAR 1957-58; Bhan 1989
151	Kalianpur	Jamnagar	21° 50' 00" N	69° 25' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
152	Kalibhai ni Vadi	Ahmedabad	22° 15' ‘ 54" N	71° 51' 19" E	Dimri 1999
153	Kalyanpur Three	Jamnagar	21° 41' 00" N	69° 37' 00" E	Bhan 1986
154	Kanadia Thumdo	Rajkot	24° 01' 00" N	71° 28' 50" E	Ajithprasad and Sonawane (in press)
155	Kanakrialo Thumdo (Charandha Two)	Banaskantha	23° 60' 00" N	71° 30' 00" E	Majumdar 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
156	Kanasutaria	Ahmedabad	22° 47' 00" N	72° 16' 00" E	IAR 1954-55; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
157	Kanewal; Kesari Sing no Timbo	Kheda	22° 28' 00" N	72° 30' 00" E	IAR 1972-73; 1974-75; 1977-78; Momin 1979
158	Kanewal; Sai No Tekro	Kheda	22° 27' 00" N	72° 30' 00" E	IAR 1972-73; 1974-75; 1977-78; Momin 1979
159	Kanjetar	Amreli	20° 45' 00" N	70° 40' 00" E	IAR 1956-57; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
160	Karedia no Timbo	Ahmedabad	22° 19' 18" N	71° 42' 02" E	Dimri 1999
161	Kasano Relo	Surendranagar	23° 27' 00" N	71° 29' 20" E	Bhan 1994
162	Katadia-no Thumdo	Banaskantha	23° 55' 10" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
163	Katasar	Kachchh	23° 34' 00" N	70° 29' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
164	Kedia Timbo	Ahmedabad	22° 19' 52" N	71° 54' 29" E	Dimri 1999
165	Kerali	Rajkot	22° 00' 00" N	70° 20' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; Possehl 1999
166	Kerlavlo	Bhavnagar	21° 51' 24" N	71° 39' 32" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
167	Khakhar	Kheda	22° 27' 00" N	72° 30' 00" E	Momin 1979
168	Khakhariya no Timbo (Juna Ishvariya)	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Jairath 1986
169	Khambala no Dhoro	Amreli	-	-	Possehl 1999
170	Khambhlav	Surendranagar	22° 32' 10" N	71° 54' 50" E	Dimri 1999
171	Khambhodhar	Jamnagar	21° 45' 00" N	69° 35' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
172	Khanderio One	Bhavnagar	21° 58' 00" N	71° 29' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
173	Khanderio Two	Bhavnagar	21° 58' 00" N	71° 30' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
174	Khari Timbo	Ahmedabad	22° 17' 45" N	71° 58' 50" E	Dimri 1999
175	Kharsaliya	Ahmedabad	22° 14' 27" N	71° 55' 31" E	Dimri 1999
176	Khatariyo-na Timbo	Mehsana	23° 42' 00" N	71° 51' 00" E	Bhan 1994
177	Kherio-no Timbo (Kerala)	Bhavnagar	22° 02' 00" N	71° 29' 00" E	Jairath 1986
178	Khetarvalo	Bhavnagar	21° 48' 00" N	71° 37' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
179	Kheth Talvadi	Mehsana	23° 39' 30" N	71° 45' 10" E	IAR 1982-83; Joshi *et al.* 1984; Bhan 1994
180	Khodiyar; Talaja	Bhavnagar	21° 24' 05" N	71° 59' 24" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
181	Kindar Kheda	Porbandar	21° 47' 50" N	69° 37' 50" E	Gaur and Sundaresh; 2005
182	Kindarkhera	Junagadh	21° 48' 00" N	69° 33' 00" E	Rao 1963; Ghosh 1989
183	Koba	Rajkot	21° 45' 00" N	70° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
184	Kodir Mata no Mandir	Surendranagar	22° 25' 50" N	72° 47' 30" E	Dimri 1999
185	Kodir Mata no Timbo	Ahmedabad	22° 21' 25" N	71° 52' 30" E	Dimri 1999
186	Kotada Bhadli One	Kachchh	23° 22' 00" N	69° 26' 00" E	IAR 1965-66; Possehl 1980; 1999; Joshi *et al.* 1984
187	Kotada; Kachchh	Kachchh	23° 18' 00" N	70° 06' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
188	Koth	Ahmedabad	22° 38' 00" N	72° 18' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
189	Kothoda no Thumdo (Mathutra Three)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
190	Kumar	Mehsana	23° 27' 00" N	71° 46' 00" E	IAR 1978-79
191	Kundanpur	Rajkot	22° 05' 00" N	71° 10' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
192	Kuntasi	Rajkot	22° 50' 40" N	70° 37' 30" E	IAR 1977-78; IAR 1987-88; Dhavalikar *et al.* 1996
193	Labro no Khetar	Surendranagar	22° 25' 50" N	71° 53' 20" E	Dimri 1999
194	Ladai	Kachchh	-	-	IAR 1955-56
195	Lakahar no Thumdo (Ranmalpura Four)	Banaskantha	23° 45' 00" N	71° 09' 00" E	Majumdar 1999
196	Laketra no Timbo (Visnagar One)	Surendranagar	23° 28' 00" N	71° 34' 00" E	Majumdar 1999
197	Lakhabawal	Jamnagar	22° 24' 00" N	70° 00' 00" E	IAR 1955-56; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
198	Lakhadungri	Surendranagar	22° 34' 50" N	71° 49' 50" E	Dimri 1999
199	Lakhanka	Bhavnagar	21° 48' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
200	Lakhapur	Kachchh	23° 33' 00" N	70° 28' 00" E	IAR 1965-66; Ghosh 1989
201	Lakhavarno Dhoro	Amreli	-	-	Possehl 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
202	Lakhavav (Visnagar One)	Amreli	21° 51' 00" N	71° 27' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; Possehl 1999
203	Lakhetra-no Timbo	Surendranagar	23° 27' 00" N	71° 33' 00" E	Bhan 1994
204	Lakhneyani Thumdo One	Mehsana	23° 39' 00" N	71° 34' 00" E	Ajithprasad and Sonawane (in press); Bhan 1994
205	Laloino Timbo	Jamnagar	22° 12' 00" N	70° 14' 00" E	IAR 1980-81; Bhan 1989
206	Levana-no Godh	Banaskantha	23° 49' 00" N	71° 35' 00" E	Ajithprasad and Sonawane (in press)
207	Liad Two	Surendranagar	22° 30' 55" N	72° 48' 20" E	Dimri 1999
208	Lihimo no Timbo	Surendranagar	22° 34' 20" N	71° 53' 10" E	Majumdar 1999
209	Limbadka-no Thumdo	Banaskantha	23° 54' 00" N	71° 31' 00" E	Ajithprasad and Sonawane (in press)
210	Limbuni-no Godh	Banaskantha	24° 09' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
211	Linedoriwalo Khetar	Surendranagar	23° 27' 00" N	71° 34' 00" E	Bhan 1994
212	Lolada	Mehsana	23° 33' 00" N	71° 41' 00" E	IAR 1978-79; Bhan 1994
213	Lolai	Jamnagar	22° 12' 00" N	70° 14' 00" E	Bhan 1986
214	Lothal	Ahmedabad	22° 31' 25" N	72° 14' 59" E	Rao 1963; Rao 1976; Rao 1985; Possehl 1999; Joshi *et al.* 1984
215	Lukhela	Rajkot	21° 50' 00" N	70° 00' 00" E	IAR 1958-59; Possehl 1980; Possehl 1999
216	Machiala Mota	Amreli	21° 41' 00" N	71° 14' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
217	Madan Kundala Gondal	Rajkot	-	-	IAR 1983-84
218	Madeva	Amreli	21° 50' 00" N	71° 24' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
219	Madhi	Amreli	21° 45' 00" N	70° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
220	Mahadevio	Amreli	21° 54' 00" N	71° 17' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984
221	Mahadevno Timbo	Amreli	-	-	Possehl 1999
222	Malgam	Rajkot	22° 01' 00" N	71° 26' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
223	Malwan	Surat	21° 06' 00" N	72° 43' 00" E	IAR 1967-68; Possehl 1980; 1999; Joshi *et al.* 1984
224	Maran	Surendranagar	22° 27' 50" N	71° 51' 53" E	Majumdar 1999
225	Mataji-no Timbo	Surendranagar	23° 25' 35" N	71° 51' 50" E	IAR 1982-83; Hegde and Sonawane 1986

S.No.	Site Name	District/River	Latitude	Longitude	References
226	Mata-no Thumdo	Banaskantha	23° 59' 00" N	71° 26' 30" E	Ajithprasad and Sonawane (in press)
227	Mayo no khado (Valabhipur)	Bhavnagar	22° 41' 15" N	71° 38' 31" E	IAR 1957-58; Ghosh 1989
228	Meghapar	Rajkot	-	-	Possehl 1999
229	Mehgam	Bharuch	21° 42' 00" N	72° 45' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
230	Mehtawari	Diu	20° 44' 00" N	70° 55' 00" E	IAR 1981-82
231	Melana Four	Bhavnagar	21° 55' 40" N	71° 46' 50" E	Possehl 1999
232	Mepla-no Thumdo	Banaskantha	23° 46' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
233	Moda	Jamnagar	-	-	Majumdar 1999
234	Moda no Thumdo	Banaskantha	23° 45' 00" N	71° 09' 00" E	IAR 1953-54; Ghosh 1989
235	Modhera	Mehsana	-	-	Rao 1963; Ghosh 1989
236	Mora	Jamnagar	22° 28' 00" N	70° 14' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
237	Moriyo no Timbo	Ahmedabad	22° 18' 20" N	72° 01' 02" E	Rao 1963; Ghosh 1989
238	Morpur	Jamnagar	22° 16' 00" N	69° 49' 00" E	IAR 1978-79; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1986
239	Moti Gop	Jamnagar	22° 19' 00" N	69° 30' 00" E	Bhan 1986
240	Moti Kalavad	Jamnagar	-	-	IAR 1961-62
241	Moti Parbadi	Rajkot	-	-	Possehl 1999
242	Mul Madhavpur	Jamnagar	-	-	IAR 1961-62; Ghosh 1989
243	Mullada Two	Surendranagar	23° 18' 00" N	71° 44' 00" E	Bhan 1994
244	Mulpadar; Kalianpar	Jamnagar	21° 56' 00" N	69° 45' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989
245	Nagadia	Jamnagar	21° 55' 00" N	69° 33' 00" E	IAR 1979-80
246	Nageshri	Bhavnagar	-	-	Chitalwala 1985
247	Nagwada Five	Surendranagar	23° 17' 50" N	71° 43' 00" E	Ajithprasad and Sonawane (in press)
248	Nagwada Three	Surendranagar	23° 18' 50" N	71° 42' 30" E	IAR 1984-85; Bhan 1994
249	Nagwada Two	Surendranagar	23° 19' 00" N	71° 43' 15" E	IAR 1984-85; Bhan 1994
250	Nana Khara (Langala)	Bhavnagar	21° 48' 00" N	71° 43' 00" E	Jairath 1986
251	Nani Chandur	Mehsana	23° 35' 00" N	71° 37' 30" E	Bhan 1994
252	Narmana One	Jamnagar	22° 15' 00" N	70° 09' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1989

S.No.	Site Name	District/River	Latitude	Longitude	References
253	Narmana Two	Jamnagar	-	-	Bhan 1983
254	Nashado	Surendranagar	22° 33' 30" N	71° 43' 50" E	Dimri 1999
255	Nashado One	Ahmedabad	22° 28' 30" N	71° 57' 51" E	Dimri 1999
256	Nashado Two	Ahmedabad	22° 15' 00" N	71° 52' 12" E	Dimri 1999
257	Nelavada	Amreli	-	-	Possehl 1999
258	Nesada (Tarasamia)	Bhavnagar	-	-	Jairath 1986
259	Neshado	Ahmedabad	22° 27' 13" N	71° 48' 58" E	Dimri 1999
260	Neshdo	Amreli	21° 53' 00" N	71° 23' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
261	Nikawa One	Jamnagar	22° 11' 00" N	70° 36' 00" E	Bhan 1986
262	Odherio Timbo (Loteshwar Two)	Mehsana	23° 36' 20" N	71° 49' 00" E	Bhan 1994
263	Old Alatala	Bhavnagar	-	-	IAR 1960-61
264	Oliya Peer	Jamnagar	21° 16' 00" N	70° 01' 00" E	IAR 1980-81; Bhan 1983
265	Ori-no Thumdo	Banaskantha	23° 50' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
266	Oriyo Timbo	Bhavnagar	21° 53' 12" N	71° 36' 16" E	IAR 1984-85; Rissman 1985; Rissman and Chitalwala 1990; Reddy 1991
267	Oriyodada-no Timbo	Surendranagar	23° 23' 00" N	71° 48' 00" E	Hegde and Sonawane 1986
268	Orumana	Mehsana	23° 36' 00" N	71° 53' 40" E	Bhan 1994
269	Pabumath	Kachchh	23° 37' 00" N	70° 31' 40" E	IAR 1977-78; Possehl 1980; 1999; Joshi *et al.* 1984
270	Pachahari no Thumdo (Ranmalpura Two)	Banaskantha	23° 45' 00" N	71° 09' 00" E	Majumdar 1999
271	Padadhari	Rajkot	-	-	IAR 1978-79
272	Padar no Timbo (Khijadiya)	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Jairath 1986
273	Padra	Kheda	22° 28' 00" N	72° 33' 00" E	Momin 1979
274	Pagiyavalo no Thumdo (Mathutra Four)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
275	Pancha Pipro	Jamnagar	22° 02' 00" N	70° 05' 00" E	IAR 1980-81; Bhan 1989
276	Panchpit	Ahmedabad	22° 22' 47" N	71° 52' 39" E	Dimri 1999
277	Pansina	Surendranagar	22° 31' 00" N	71° 55' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
278	Paria; Waro Mohra	Kachchh	23° 06' 00" N	70° 05' 00" E	IAR 1986-87
279	Pasegam	Bhavnagar	21° 51' 14" N	71° 38' 48" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
280	Patel Raniji Ka Magsa	Kachchh	23° 06' 00" N	70° 11' 00" E	IAR 1986-87
281	Patel-no Khetar	Banaskantha	23° 51' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
282	Pavateswar Mahadev	Ahmedabad	22° 10' 00" N	71° 54' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
283	Pavateswar Mahadev	Bhavnagar	-	-	IAR 1959-60; Ghosh 1989\
284	Peerni Durga	Jamnagar	22° 17' 00" N	70° 04' 00" E	IAR 1980-81; Bhan 1983; Bhan 1989
285	Pepadia Timbo	Banaskantha	23° 50' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
286	Phala	Jamnagar	22° 18' 00" N	70° 32' 00" E	IAR 1954-55; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
287	Phul Timbo	Bhavnagar	21° 50' 51" N	71° 43' 30" E	Possehl 1980; 1999; Joshi *et al.* 1984
288	Phul Wadi	Bhavnagar	21° 51' 00" N	71° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
289	Pipalia-no Dhoro (Sidsar)	Bhavnagar	21° 43' 00" N	72° 05' 00" E	Jairath 1986
290	Pipartoda One	Jamnagar	22° 02' 00" N	70° 05' 00" E	Bhan 1986
291	Pipartoda Two	Jamnagar	22° 02' 00" N	70° 05' 00" E	Bhan 1986
292	Pipplage	Amreli	-	-	IAR 1978-79
293	Piriya no Timbo (Kuvarad Two)	Mehsana	23° 32' 00" N	71° 51' 00" E	Majumdar 1999
294	Pirno Dhoro	Amreli	-	-	Possehl 1999
295	Pirojpur	Mehsana	23° 25' 00" N	71° 50' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1994
296	Pitar	Jamnagar	22° 41' 00" N	70° 32' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
297	Pitaria	Rajkot	21° 35' 00" N	70° 55' 00" E	IAR 1957-58; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
298	Pithad One	Jamnagar	22° 41' 00" N	70° 32' 00" E	Bhan 1986
299	Pithadia; Jamnagar	Jamnagar	22° 24' 00" N	70° 29' 00" E	Bhan 1986
300	Pithadia; Rajkot	Rajkot	21° 46' 00" N	70° 40' 00" E	IAR 1957-58; Joshi *et al.* 1984; Possehl 1980; Possehl 1999
301	Popatpura	Kheda	22° 35' 00" N	72° 32' 00" E	Momin 1979
302	Prabhas Patan (Somnath)	Junagadh	20° 53' 00" N	70° 24' 00" E	Nanavati *et al.*1971; Dhavalikar and Possehl 1992
303	Priya-no Timbo	Mehsana	23° 33' 35" N	71° 52' 30" E	Ajithprasad and Sonawane (in press)
304	Rahlavadar	Bhavnagar	-	-	Possehl 1980; Possehl 1999
305	Rajda	Jamnagar	22° 11' 00" N	70° 36' 00" E	Bhan 1986
306	Rajpipla Eight	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
307	Rajpipla Five	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
308	Rajpipla Four	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
309	Rajpipla Nine	Bhavnagar	21° 51' 00" N	71° 34' 00" E	Joshi *et al.* 1984
310	Rajpipla One	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
311	Rajpipla Seven	Bhavnagar	21° 52' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
312	Rajpipla Six	Bhavnagar	21° 52' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
313	Rajpipla Three	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
314	Rajpipla Two	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
315	Rajthali	Bhavnagar	21° 50' 00" N	71° 48' 00" E	Jairath 1986
316	Rajwadio Timbo	Mehsana	23° 35' 00" N	71° 51' 00" E	Bhan 1994
317	Rakhodio Doro (Dharuka)	Bhavnagar	21° 49' 00" N	71° 52' 00" E	Jairath 1986
318	Rampara One	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
319	Rampara Two	Bhavnagar	21° 58' 00" N	71° 29' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
320	Rampur	Jamnagar	22° 17' 00" N	70° 04' 00" E	Bhan 1986
321	Randal Dadwa	Rajkot	-	-	IAR 1983-84
322	Randia no Thumdo (Datrana Nine)	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
323	Rangpur	Surendranagar	22° 23' 56" N	71° 55' 19" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
324	Ranol-no Timbo	Surendranagar	23° 23' 00" N	71° 38' 00" E	IAR 1984-85; Bhan 1994
325	Ranparda	Jamnagar	21° 55' 00" N	69° 23' 00" E	IAR 1957-58; Rao 1963; Bhan 1986
326	Rasnal	Jamnagar	22° 41' 00" N	70° 35' 00" E	IAR 1958-59; Bhan 1986
327	Ratanpura	Mehsana	23° 28' 00" N	71° 48' 00" E	IAR 1984-85
328	Rojasar	Ahmedabad	22° 21' 32" N	72° 02' 12" E	Dimri 1999
329	Rojdi	Rajkot	21° 51' 47" N	70° 55' 08" E	IAR 1957-58; Rao 1963; Possehl and Rawal 1989
330	Rupamore	Jamnagar	21° 60' 00" N	69° 45' 00" E	IAR 1978-79; Bhan 1986
331	Rustamgadh	Surendranagar	-	-	Majumdar 1999
332	Saaheer-no Timbo (Bhadi)	Bhavnagar	-	-	Jairath 1986
333	Sai devaliya	Jamnagar	-	-	Bhan 1983
334	Sai Timbo	Mehsana	23° 33' 00" N	71° 54' 00" E	Joshi *et al.* 1984; Bhan 1994
335	Samadhiala	Bhavnagar	21° 52' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
336	Samagogha	Kachchh	22° 55' 00" N	69° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
337	Sanalo	Jamnagar	22° 12' 00" N	70° 25' 00" E	Rao 1963

S.No.	Site Name	District/River	Latitude	Longitude	References
338	Sankatrawalo Thumdo	Banaskantha	23° 54' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
339	Santhli Five	Banaskantha	23° 54' 15" N	71° 29' 50" E	Ajithprasad and Sonawane (in press)
340	Santhli Six	Banaskantha	23° 54' 00" N	71° 30' 20" E	Ajithprasad and Sonawane (in press)
341	Sarkhadolino Timbo	Mehsana	-	-	Bhan 1994
342	Sarwania	Jamnagar	22° 09' 00" N	70° 22' 00" E	Bhan 1986
343	Sasiyani Timbo	Mehsana	23° 35' 00" N	71° 51' 10" E	Hegde and Sonawane 1986; Bhan 1994
344	Seed Farm	Bhavnagar	20° 57' 52" N	71° 35' 15" E	Possehl 1980; 1999; Joshi *et al.* 1984
345	Senalo	Jamnagar	22° 12' 00" N	70° 25' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
346	Sheikpur	Surendranagar	22° 21' 57" N	71° 45' 53" E	Dimri 1999
347	Shiharu-no Thumdo	Banaskantha	23° 50' 20" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
348	Shimoyno Dhoro	Rajkot	-	-	Possehl 1999
349	Shisak	Rajkot	-	-	Possehl 1999
350	Shrinagar	Jamnagar	21° 39' 00" N	69° 37' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
351	Shrinagar	Junagadh	21° 35' 00" N	69° 34' 00" E	Rao 1963; Ghosh 1989
352	Sonaria	Jamnagar	22° 00' 00" N	69° 46' 00" E	Bhan 1988
353	Soont-no Timbo	Banaskantha	23° 56' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
354	Sujnipur	Mehsana	23° 46' 00" N	72° 12' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1994
355	Sultanpur	Amreli	21° 45' 00" N	70° 50' 00" E	Rao 1963; Ghosh 1989
356	Sultanpur	Rajkot	21° 45' 00" N	70° 50' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
357	Suryavadar One	Jamnagar	21° 56' 00" N	69° 45' 00" E	Bhan 1986
358	Talavadi no Thumdo (Mathutra Five)	Banaskantha	23° 44' 00" N	71° 05' 00" E	Majumdar 1999
359	Talewadi	Jamnagar	22° 02' 00" N	70° 05' 00" E	IAR 1980-81; Bhan 1989
360	Tankaria	Jamnagar	21° 56' 00" N	69° 25' 00" E	IAR 1979-80; Rao 1963; Possehl 1999; Joshi *et al.* 1984; Bhan 1989
361	Taraghada	Rajkot	21° 44' 00" N	70° 26' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
362	Tarana Four	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1979-80; Bhan 1989

S.No.	Site Name	District/River	Latitude	Longitude	References
363	Tarana One	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1979-80
364	Tarana Three	Jamnagar	22° 43' 00" N	70° 27' 00" E	Bhan 1989
365	Tarana Two	Jamnagar	22° 43' 00" N	70° 27' 00" E	IAR 1960-61; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
366	Tatana	Bhavnagar	21° 58' 00" N	71° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
367	Tetariyo	Amreli	21° 49' 00" N	71° 06' 00" E	IAR 1958-59; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
368	Thebachada One	Rajkot	22° 22' 00" N	70° 51' 00" E	IAR 1961-62; Possehl 1980; 1999; Joshi *et al.* 1984
369	Thebachada Two	Rajkot	22° 22' 00" N	70° 51' 00" E	Possehl 1999
370	Thikariya-no Timbo	Mehsana	23° 31' 40" N	71° 45' 20" E	Hegde and Sonawane 1986; Bhan 1994; Joshi *et al.* 1984
371	Timbo	Surendranagar	22° 23' 07" N	71° 51' 10" E	Dimri 1999
372	Timbo One	Mehsana	23° 43' 00" N	71° 36' 00" E	Bhan 1994
373	Timbo Two	Mehsana	23° 43' 10" N	71° 37' 00" E	Bhan 1994
374	Timran	Rajkot	-	-	Possehl 1999
375	Tokaria Timbo	Mehsana	23° 28' 00" N	71° 49' 30" E	IAR 1982-83; Bhan 1994
376	Vachali Ghodi	Rajkot	-	-	IAR 1978-79
377	Vadera	Amreli	21° 36' 00" N	71° 06' 00" E	IAR 1978-79; Joshi *et al.* 1984
378	Vadgam	Surendranagar	23° 21' 00" N	71° 48' 00" E	IAR 1964-65; Joshi *et al.* 1984; Bhan 1994
379	Vadia-no Timbo	Mehsana	23° 34' 00" N	71° 53' 00" E	IAR 1982-83; Joshi *et al.* 1984; Bhan 1994
380	Vadli	Rajkot	-	-	Possehl 1999
381	Vagad	Ahmedabad	22o 19' 00" N	71o 52' 00" E	Sonawane and Mehta 1985
382	Vaghania Juna	Amreli	-	-	IAR 1978-79
383	Vaghatalav	Kheda	22° 32' 00" N	72° 27' 00" E	Momin 1979
384	Vagrano Dhoro	Amreli	-	-	Possehl 1999
385	Vaharvo	Bhavnagar	21° 50' 50" N	71° 43' 55" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
386	Vaniavadar	Amreli	21° 39' 00" N	71° 09' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
387	Vankiner	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1979-80; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
388	Vanta no Thumdo (Datrana Ten)	Banaskantha	23° 46' 00" N	71° 07' 00" E	Majumdar 1999
389	Vasai	Jamnagar	22° 24' 00" N	70° 00' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1983
390	Vegadi	Rajkot	21° 47' 00" N	70° 30' 00" E	IAR 1958-59; Possehl 1980; Possehl 1999
391	Veranatha Timbo	Mehsana	23° 39' 00" N	71° 54' 10" E	Bhan 1994
392	Veraval	Jamnagar	22° 22' 00" N	69° 05' 00" E	Bhan 1986
393	Veraval Moti	Jamnagar	22° 17' 00" N	70° 04' 00" E	Bhan 1986
394	Vikrarambhai no Timbo	Ahmedabad	22° 18' 20" N	72° 01' 02" E	Dimri 1999
395	Virpur; Jamnagar	Jamnagar	22° 07' 00" N	70° 56' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1983; Joshi *et al.* 1984
396	Volda no Thumdo	Banaskantha	23° 51' 00" N	71° 20' 00" E	Majumdar 1999
397	Warthan	Surat	21° 22' 00" N	72° 51' 00" E	IAR 1961-62
398	Zekhada/Jekhda	Banaskantha	23° 51' 00" N	71° 28' 00" E	Mehta 1982
399	Zinawari	Jamnagar	-	-	Bhan 1983

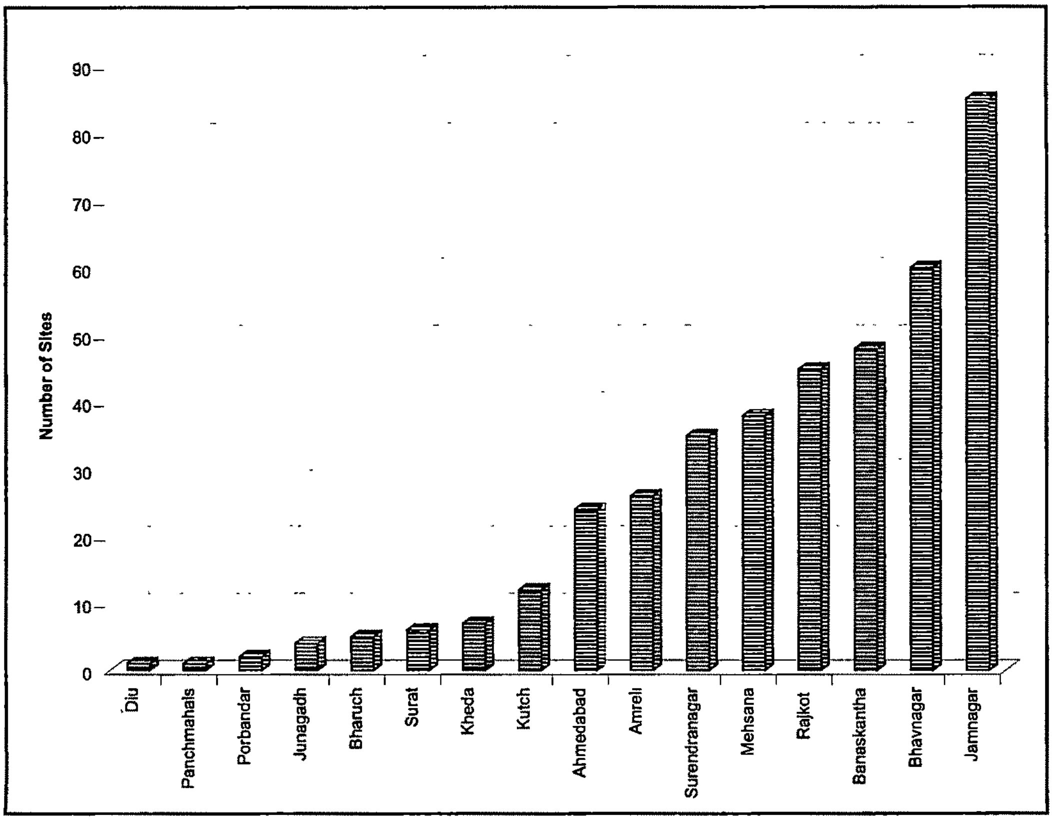

Fig. 11 District-wise distribution of Post-Urban Harappan sites in Gujarat

Table 12: Lustrous Red Ware sites in Gujarat (Post-Urban Harappan)

S.No.	Site	District	Latitude	Longitude	References
1	Adkot	Rajkot	22° 00' 00" N	71° 05' 00" E	IAR 1957-58; Ghosh 1989
2	Alatala	Bhavnagar	-	-	IAR 1960-61; Ghosh 1989
3	Ambaradi	Rajkot	-	-	IAR 1978-79
4	Amra	Jamnagar	22° 16' 00" N	69° 56' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1986
5	Atariya no Timbo	Mehsana	23° 39' 30" N	71° 55' 30" E	IAR 1982-83; Hegde and Sonawane 1986; Bhan 1994
6	Bagaya no Timbo	Mehsana	23° 25' 30" N	71° 49' 30" E	Hegde and Sonawane 1986; Bhan 1994
7	Beyt Dwaraka	Jamnagar	22° 20' 00" N	69° 05' 00" E	IAR 1969-70; Joshi *et al.* 1984; Bhan 1986
8	Bhalbhai no Timbo	Mehsana	23° 27' 00" N	71° 46' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1994
9	Bhangor	Jamnagar	22° 05' 00" N	69° 22' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
10	Bhatiwadi	Amreli	21° 45' 00" N	70° 50' 00" E	IAR 1957-58; Possehl 1980; 1999; Joshi *et al.* 1984
11	Bhbhuro Dhoro	Amreli	-	-	Possehl; 1999
12	Bhoklidhar	Bhavnagar	21° 58' 00" N	71° 38' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
13	Bhutawed- no Godh	Banaskantha	23° 51' 00" N	71° 23' 00" E	Ajithprasad and Sonawane (in press)
14	Binanagari	Jamnagar	22° 43' 00" N	70° 22' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
15	Borawalo Khetra	Mehsana	23° 42' 00" N	71° 51' 00" E	IAR 1982-83; Hegde and Sonawane 1986; Bhan 1994
16	Chachana	Surendranagar	22° 25' 00" N	71° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
17	Chandrawara One	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1957-58; Possehl 1980; 1999; Bhan 1986
18	Chandrawara Two	Jamnagar	21° 50' 00" N	69° 25' 00" E	IAR 1957-58; Possehl 1980; 1999; Bhan 1986
19	Chanidhar	Jamnagar	22° 16' 00" N	70° 01' 00" E	Bhan 1983
20	Chaniyathar No Timbo	Banaskantha	23° 31' 00" N	71° 44' 00" E	Bhan 1994
21	Chipa-no Godh	Banaskantha	23° 45' 00" N	71° 16' 30" E	Ajithprasad and Sonawane (in press)

S.No.	Site Name	District/River	Latitude	Longitude	References
22	Chota Isvaria	Bhavnagar	21° 58' 00" N	71° 42' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
23	Daidungri	Rajkot	22° 00' 00" N	71° 05' 00" E	Rao 1963; Possehi 1980; Joshi *et al.* 1984
24	Dared Two	Bhavnagar	21° 58' 00" N	71° 46' 00" E	Possehl 1999
25	Datrana One	Banaskantha	23° 46' 10" N	71° 07' 00" E	Ajithprasad and Sonawane (in press)
26	Datrana Two	Banaskantha	23° 46' 00" N	71° 07' 10" E	Ajithprasad and Sonawane (in press)
27	Deriwalokhetra One	Mehsana	23° 30' 20" N	71° 55' 30" E	Joshi *et al.* 1984; Bhan 1994
28	Devalio	Amreli	21° 53' 00" N	71° 23' 00" E	IAR 1955-56; Possehl 1980; 1999; Joshi et al. 1984
29	Devaliyo	Amreli	21° 52' 00" N	71° 25' 00" E	IAR 1955-56; Ghosh 1989
30	Devalkano Doro	Rajkot	-	-	Possehl 1999
31	Dharovadno Timbo	Surendranagar	23° 23' 30" N	71° 48' 00" E	IAR 1984-85; Bhan 1994
32	Dhoraji	Rajkot	-	-	IAR 1978-79
33	Dhrufaniya	Rajkot	-	-	IAR 1982-83
34	Dhurasiano Timbo	Rajkot	-	-	Possehl 1999
35	Dwarka	Jamnagar	22° 13' 00" N	69° 00' 00" E	IAR 1979-80; Bhan 1986
36	Gadhiyano Timbo	Mehsana	23° 31' 00" N	71° 53' 00" E	Joshi *et al.* 1984; Bhan 1984
37	Godha	Banaskantha	23° 36' 00" N	71° 28' 00" E	Bhan 1994
38	Godha	Mehsana	23° 40' 00" N	71° 36' 00" E	Bhan 1994
39	Godhiya-no Timbo	Mehsana	23° 30' 10" N	71° 53' 30" E	Ajithprasad and Sonawane (in press)
40	Haripur One	Jamnagar	22° 16' 00" N	70° 01' 00" E	Bhan 1986
41	Harthar-no Timbo	Mehsana	23° 26' 00" N	71° 49' 00" E	Hegde and Sonawane 1986; Bhan 1994
42	Hasanpur	Surat	21° 25' 00" N	72° 46' 00" E	Joshi *et al.* 1984
43	Hemadra	Rajkot	-	-	Possehl 1999
44	Holivalo	Bhavnagar	21° 57' 00" N	71° 40' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
45	Inderwa-no Timbo One	Banaskantha	24° 01' 10" N	71° 28' 00" E	Ajithprasad and Sonawane (in press)
46	Jagtapirno Dhoro	Rajkot	-	-	Possehl 1999
47	Jaidak/Pithad	Jamnagar	22° 40' 00" N	70° 35' 00" E	Rao 1963; IAR 1979 1980; Possehl 1999; Joshi *et al.* 1984
48	Janoya-no Timbo	Surendranagar	23° 25' 00" N	71° 51' 20" E	Hegde and Sonawane 1986; Bhan 1994
49	Jasapar	Jamnagar	22° 12' 00" N	70° 25' 00" E	Bhan 1986
50	Jhandada-no Thumdo One	Banaskantha	23° 54' 20" N	71° 27' 00" E	Ajithprasad and Sonawane (in press)
51	Kachcha-no Thumdo	Banaskantha	23° 53' 00" N	71° 24' 30" E	Ajithprasad and Sonawane (in press)

S.No.	Site Name	District/River	Latitude	Longitude	References
52	Kacho Timbo	Mehsana	23° 25' 00" N	71° 45' 00" E	IAR 1978-79; Joshi *et al.*1984; Bhan 1984
53	Kalari no Timbo	Mehsana	23° 30' 10" N	71° 45' 00" E	Hegde and Sonawane 1986; Bhan 1994
54	Kalyanpur Three	Jamnagar	21° 41' 00" N	69° 37' 00" E	Bhan 1986
55	Kanasutaria	Ahmedabad	22° 47' 00" N	72° 16' 00" E	IAR 1954-55; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
56	Kanewal; Keseri Sing no Timbo	Kheda	22° 28' 00" N	72° 30' 00" E	IAR 1972-73; IAR 1974-75:; IAR 1977-78; Momin 1979
57	Kanewal; Sai no Tekro	Kheda	22° 27' 00" N	72° 30' 00" E	IAR 1972-73; IAR 1974-75:; IAR 1977-78; Momin 1979
58	Kasano Relo	Surendranagar	23° 27' 00" N	71° 29' 20" E	Bhan 1994
59	Khakhar	Kheda	22° 27' 00" N	72° 30' 00" E	Momin 1979
60	Khetarvalo	Bhavnagar	21° 48' 00" N	71° 37' 00" E	IAR 1960-61; Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
61	Kheth Talvadi	Mehsana	23° 39' 30" N	71° 45' 10" E	IAR 1982-83; Joshi *et al.* 1984; Bhan 1994
62	Kotada Bhadli One	Kachchh	23° 22' 00" N	69° 26' 00" E	IAR 1965-66; Possehl 1980; Possehl 19995; Joshi *et al.* 1984
63	Kotada; Kachchh	Kachchh	23° 18' 00" N	70° 06' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
64	Kumar	Mehsana	23° 27' 00" N	71° 46' 00" E	IAR 1978-79
65	Lakhabawal	Jamnagar	22° 24' 00" N	70° 00' 00" E	IAR 1955-56; Rao 1963; Joshi *et al.* 1984; Possehl 1999 Bhan 1989
66	Lakhavav	Amreli	21° 51' 00" N	71° 27' 00" E	IAR 1960-61 Rao 1963; Possehl 1980; Possehl 1999
67	Lakhetra-no Timbo	Surendranagar	23° 27' 00" N	71° 33' 00" E	Bhan 1994
68	Lakhneyani Thumdo One	Mehsana	23° 39' 00" N	71° 34' 00" E	Ajithprasad and Sonawane (in press); Bhan 1994
69	Limbuni-no Godh	Banaskantha	24° 09' 00" N	71° 20' 00" E	Ajithprasad and Sonawane (in press)
70	Linedoriwalo Khetra	Surendranagar	23° 27' 00" N	71° 34' 00" E	Bhan 1994
71	Lukhela	Rajkot	21° 50' 00" N	70° 00' 00" E	IAR 1958-59; Possehl 1980; 1999; Possehl 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
72	Machiala Mota	Amreli	21° 41' 00" N	71° 14' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
73	Madhi	Amreli	21° 45' 00" N	70° 50' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
74	Mataji-no Timbo	Surendranagar	23° 25' 35" N	71° 51' 50" E	IAR 1982-83; Hegde and Sonawane 1986
75	Meghapar	Rajkot	-	-	Possehl 1999
76	Mehtawari	Diu	20° 44' 00" N	70° 55' 00" E	IAR 1981-82
77	Morpur	Jamnagar	22° 16' 00" N	69° 49' 00" E	IAR 1978-79; Rao 1963; Joshi *et al.* 1984; Possehl 1999 Bhan 1986
78	Moti Kalavad	Jamnagar	-	-	IAR 1961-62
79	Moti Parbadi	Rajkot	-	-	Possehl 1999
80	Mul Madhavpur	Jamnagar	-	-	IAR 1961-62; Ghosh 1989
81	Mullada Two	Surendranagar	23° 18' 00" N	71° 44' 00" E	Bhan 1994
82	Nagadia	Jamnagar	21° 55' 00" N	69° 33' 00" E	IAR 1979-80
83	Nageshri	Bhavnagar	-	-	Chitalwala 1985
84	Nagwada Five	Surendranagar	23° 17' 50" N	71° 43' 00" E	Ajithprasad and Sonawane (in press)
85	Nagwada Three	Surendranagar	23° 18' 50" N	71° 42' 30" E	IAR 1984-85; Bhan 1994
86	Nagwada Two	Surendranagar	23° 19' 00" N	71° 43' 15" E	IAR 1984-85; Bhan 1994
87	Nani Chandur	Mehsana	23° 35' 00" N	71° 37' 30" E	Bhan 1994
88	Old Alatala	Bhavnagar	-	-	IAR 1960-61
89	Oliya Peer	Jamnagar	21° 16' 00" N	70° 01' 00" E	IAR 1980-81; Bhan 1983
90	Ori-no Thumdo	Banaskantha	23° 50' 00" N	71° 09' 00" E	Ajithprasad and Sonawane (in press)
91	Oriyo Timbo	Bhavnagar	21° 53' 12" N	71° 36' 16" E	Joshi *et al.* 1984; IAR 1984-85; Rissman and Chitalwala 1990
92	Oriyodada-no Timbo	Surendranagar	23° 23' 00" N	71° 48' 00" E	Hegde and Sonawane 1986
93	Orumana	Mehsana	23° 36' 00" N	71° 53' 40" E	Bhan 1994
94	Padadhari	Rajkot	-	-	IAR 1978-79
95	Padra	Kheda	22° 28' 00" N	72° 33' 00" E	Momin 1979
96	Pancha Pipro	Jamnagar	22° 02' 00" N	70° 05' 00" E	IAR 1980-81; Bhan 1989
97	Patel-no Khetar	Banaskantha	23° 51' 00" N	71° 30' 00" E	Ajithprasad and Sonawane (in press)
98	Peerni Durga	Jamnagar	22° 17' 00" N	70° 04' 00" E	IAR 1980-81; Bhan 1983; Bhan 1989
99	Phul Timbo	Bhavnagar	21° 50' 51" N	71° 43' 30" E	Possehl 1980; 1999; Joshi *et al.* 1984

S.No.	Site Name	District/River	Latitude	Longitude	References
100	Phul Wadi	Bhavnagar	21° 51' 00" N	71° 40' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
101	Pipartoda One	Jamnagar	22° 02' 00" N	70° 05' 00" E	Bhan 1986
102	Pipartoda Two	Jamnagar	22° 02' 00" N	70° 05' 00" E	Bhan 1986
103	Pipplage	Amreli	-	-	IAR 1978-79
104	Pirojpur	Mehsana	23° 25' 00" N	71° 50' 00" E	IAR 1978-79; Joshi *et al.* 1984; Bhan 1994
105	Pithadia; Rajkot	Rajkot	21° 46' 00" N	70° 40' 00" E	IAR 1957-58; Joshi *et al.* 1984; Possehl 1980; Possehl 1999
106	Popatpura	Kheda	22° 35' 00" N	72° 32' 00" E	Momin 1979
107	Prabhas Patan (Somnath)	Junagadh	20° 53' 00" N	70° 24' 00" E	Nanavati *et al.*1971; Ghosh 1989
108	Priya-no Timbo	Mehsana	23° 33' 35" N	71° 52' 30" E	Ajithprasad and Sonawane (in press)
109	Rajda	Jamnagar	22° 11' 00" N	70° 36' 00" E	Bhan 1986
110	Rajpipla Seven	Bhavnagar	21° 52' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
111	Rajpipla Two	Bhavnagar	21° 51' 00" N	71° 33' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
112	Rajwadio Timbo	Mehsana	23° 35' 00" N	71° 51' 00" E	Bhan 1994
113	Rampur; Gujarat	Jamnagar	22° 17' 00" N	70° 04' 00" E	Bhan 1986
114	Randal Dadwa	Rajkot	-	-	IAR 1983-84
115	Rangpur	Surendranagar	22° 23' 56" N	71° 55' 19" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984
116	Rojdi	Rajkot	21° 51' 47" N	70° 55' 08" E	IAR 1957-58; Rao 1963; Possehl and Rawal 1989
117	Sai Timbo	Mehsana	23° 33' 00" N	71° 54' 00" E	Joshi *et al.* 1984; Bhan 1994
118	Sanalo	Jamnagar	22° 12' 00" N	70° 25' 00" E	Rao 1963
119	Sarkhadolino Timbo	Mehsana	-	-	Bhan 1994
120	Sasiyani Timbo	Mehsana	23° 35' 00" N	71° 51' 10" E	Hegde and Sonawane 1986; Bhan 1994
121	Senalo	Jamnagar	22° 12' 00" N	70° 25' 00" E	Possehl 1980; 1999; Joshi *et al.* 1984
122	Shimoyno Dhoro	Rajkot	-	-	Possehl 1999
123	Shisak	Rajkot	-	-	Possehl 1999
124	Sujnipur	Mehsana	23° 46' 00" N	72° 12' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1994
125	Talewadi	Jamnagar	22° 02' 00" N	70° 05' 00" E	IAR 1980-81; Bhan 1989
126	Taraghada	Rajkot	21° 44' 00" N	70° 26' 00" E	IAR 1958-59; Possehl 1980; 1999; Joshi *et al.* 1984
127	Thebachada Two	Rajkot	22° 22' 00" N	70° 51' 00" E	Possehl 1999

S.No.	Site Name	District/River	Latitude	Longitude	References
128	Thikariya-no Timbo	Mehsana	23° 31' 40" N	71° 45' 20" E	Hegde and Sonawane 1986; Bhan 1994; Joshi *et al.* 1984
129	Timbo One	Mehsana	23° 43' 00" N	71° 36' 00" E	Bhan 1994
130	Timbo Two	Mehsana	23° 43' 10" N	71° 37' 00" E	Bhan 1994
131	Timran	Rajkot	-	-	Possehl 1999
132	Tokaria Timbo	Mehsana	23° 28' 00" N	71° 49' 30" E	IAR 1982-83; Bhan 1994
133	Vachali Ghodi	Rajkot	-	-	IAR 1978-79
134	Vadgam	Surendranagar	23° 21' 00" N	71° 48' 00" E	IAR 1964-65; Joshi *et al.* 1984; Bhan 1994
135	Vadia-no Timbo	Mehsana	23° 34' 00" N	71° 53' 00" E	IAR 1982-83; Joshi *et al.* 1984; Bhan 1994
136	Vadli	Rajkot	-	-	Possehl 1999
137	Vaghania Juna	Amreli	-	-	IAR 1978-79
138	Vaghatalav	Kheda	22° 32' 00" N	72° 27' 00" E	Momin 1979
139	Vasai	Jamnagar	22° 24' 00" N	70° 00' 00" E	Rao 1963; Possehl 1980; 1999; Joshi *et al.* 1984; Bhan 1983
140	Vegadi	Rajkot	21° 47' 00" N	70° 30' 00" E	IAR 1958-59; Possehl 1980; Possehl 1999
141	Veranatha Timbo	Mehsana	23° 39' 00" N	71° 54' 10" E	Bhan 1994
142	Veraval	Jamnagar	22° 22' 00" N	69° 05' 00" E	Bhan 1986
143	Veraval Moti	Jamnagar	22° 17' 00" N	70° 04' 00" E	Bhan 1986
144	Virpur; Jamnagar	Jamnagar	22° 07' 00" N	70° 56' 00" E	Rao 1963; Possehl 1980; 1999; Bhan 1983; Joshi *et al.* 1984

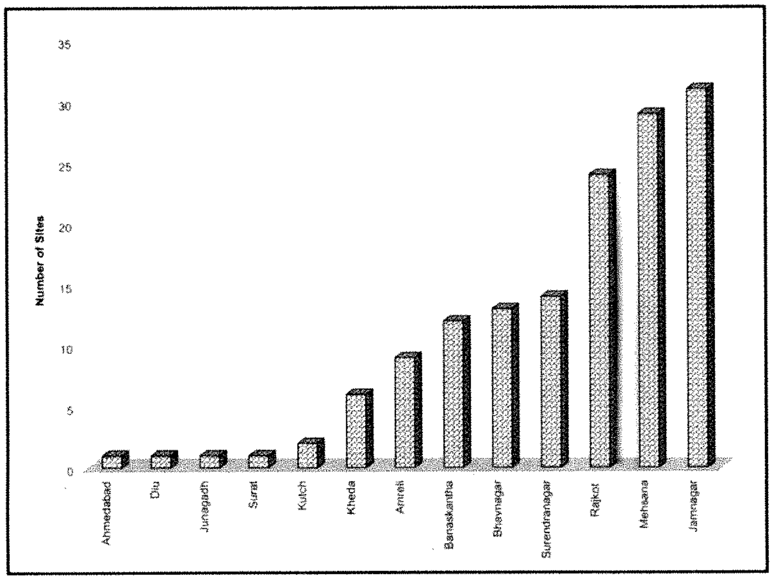

Fig. 12 District-wise distribution of Lustrous Red Ware (Post-Urban Harappan) sites in Gujarat

Table 13: Harappan sites of unspecified stages in Gujarat

S.No.	Site	District	Latitude	Longitude	References
1	Akata	Mehsana	-	-	Majumdar 1999
2	Amasino Tekro	Banaskantha	23° 32' 00" N	71° 29' 00" E	Bhan 1994
3	Baraniya	Ahmedabad	22° 19' 00" N	72° 49' 00" E	Mirchandani 1981
4	Benap	Banaskantha	-	-	IAR 1966-67; Ghosh 1989
5	Beyt	Jamnagar	-	-	Bhan 1983
6	Bharuch (Left bank of Narmada)	Bharuch	-	-	Ghosh 1989
7	Bhutakotada	Surendranagar	-	-	IAR 1962-63; Ghosh 1989
8	Bodiyo	Rajkot	-	-	IAR 1958-59; Ghosh 1989
9	Bokhalidhar (Lakhanka)	Bhavnagar	-	-	IAR 1971-72; Ghosh 1989
10	Chravad Three	Jamnagar	-	-	Majumdar 1999
11	Devalio	Bhavnagar	-	-	IAR 1960-61
12	Dhankanio	Rajkot	-	-	IAR 1958-59; Ghosh 1989
13	Dulakot	-	-	-	Chitalwala 1985
14	Dumas	-	-	-	Chitalwala 1985
15	Gadharia	Rajkot	-	-	IAR 1957-58; Ghosh 1989
16	Hajanala	Rajkot	-	-	IAR 1959-60; Ghosh 1989
17	Halenda	Rajkot	-	-	IAR 1957-58; Ghosh 1989
18	Haratharno Timbo	Mehsana	23° 25' 00" N	71° 48' 00" E	Bhan 1994
19	Jabalanes no Timbo	Ahmedabad	-	-	IAR 1966-67; Ghosh 1989
20	Jam Ambardi	Rajkot	-	-	IAR 1957-58; Ghosh 1989
21	Jam Kandorna	Rajkot	-	-	IAR 1956-57; Ghosh 1989
22	Jawarj	Ahmedabad	22° 34' 00" N	72° 16' 00" E	Mirchandani 1981
23	Jhanjmer	Rajkot	-	-	IAR 1957-58; Ghosh 1989
24	Kalavad One	Jamnagar	-	-	IAR 1954-55; Ghosh 1989
25	Keravalo	Bhavnagar	-	-	IAR 1960-61
26	Keriya	Mehsana	-	-	Majumdar 1999
27	Khandadhar	Rajkot	-	-	IAR 1957-58; Ghosh 1989
28	Khankhara Bela Two	Rajkot	-	-	IAR 1960-61; Ghosh 1989
29	Khatli	Rajkot	-	-	IAR 1957-58; Ghosh 1989
30	Kotadi	Kachchh	-	-	Ghosh 1989
31	Kundni	Rajkot	-	-	IAR 1957-58; Ghosh 1989
32	Madhapar	Kachchh	-	-	Rao 1963; Ghosh 1989

S.No.	Site Name	District/River	Latitude	Longitude	References
33	Mahadevayo	Bhavnagar	-	-	IAR 1957-58; Ghosh 1989
34	Mala Talav	Ahmedabad	22° 29 ' 00" N	72° 02' 00" E	Jairath 1986
35	Mandal	Rajkot	-	-	Dimri 1999
36	Moti Khilori	Rajkot	-	-	IAR 1955-56; Ghosh 1989
37	Nana Ishvariya	Bhavnagar	-	-	IAR 1971-72; Ghosh 1989
38	Navagam	Junagadh	-	-	IAR 1957-58; Ghosh 1989
39	Navapur	Ahmedabad	-	-	IAR 1972-73; Ghosh 1989
40	Padana	Ahmedabad	22° 19' 50" N	71° 56' 00" E	Mirchandani 1981
41	Parewala	Rajkot	-	-	IAR 1957-58; Ghosh 1989
42	Randaliyo	Rajkot	-	-	IAR 1958-59; Ghosh 1989
43	Ranpur	Ahmedabad	22° 45' 00" N	72° 34' 50"E	Mirchandani 1981
44	Saladi	Mehsana	-	-	Majumdar 1999
45	Samadhiya Vagad	Ahmedabad	22° 19' 00" N	71° 57' 00" E	Mirchandani 1981
46	Santhali	Rajkot	-	-	IAR 1957-58; Ghosh 1989
47	Vadiya Valo Dharo	Bhavnagar	-	-	IAR 1971-72; Ghosh 1989
48	Vallabhipura	Surendranagar	-	-	IAR 1962-63; Ghosh 1989
49	Vejalpur	Bharuch	-	-	IAR 1958-59
50	Vora Kotra	Rajkot	-	-	IAR 1957-58; Ghosh 1989

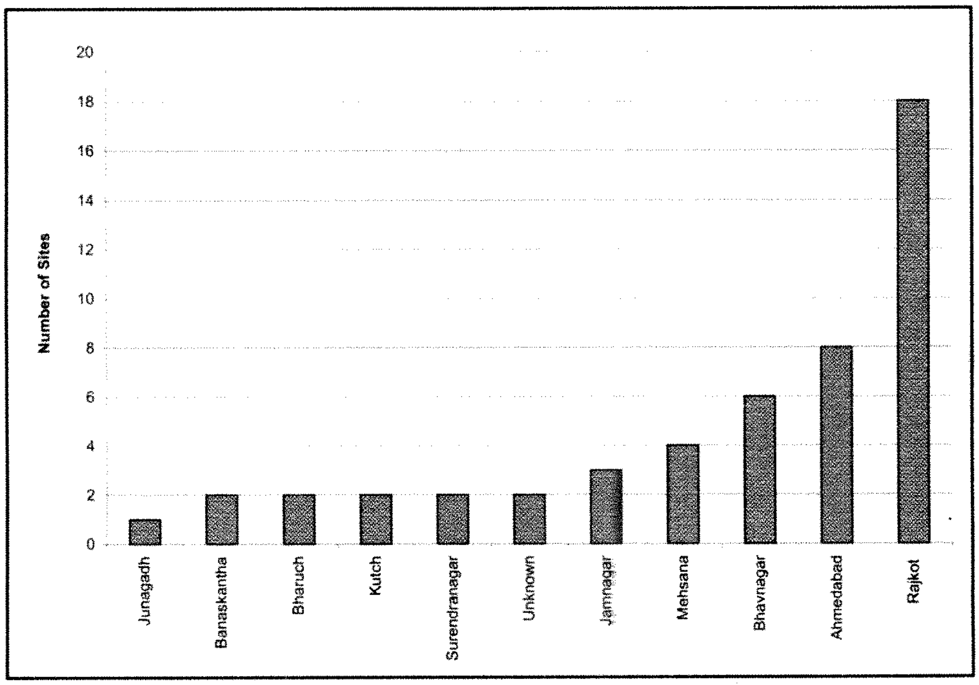

Fig. 13 District-wise distribution of unspecified Harappan sites in Gujarat

P.V. Pathak, *Man and Environment* XXXII(2): 137-139 [2007].
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A Note on the Bad-ī-sad-o-bist Winds in Afghanistan

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Maruts: The Afghan Deities

The Ṛgvedic Maruts are major deities in the Ṛgvedic pantheon of gods. As it is understood today, they represent wind gods. These were powerful and different from *vāyu*. While *vāyu* is never compared to birds, Maruts are often thus compared (e.g. RV 1.87.2, 1.88.1). In the *cāturmāsya* (i.e. four months long), ceremonies, they are accorded a high place and honoured with oblations. Hillebrandt (1965:II 185), pointing to many other rites in different *yajña* ceremonies suggested that "... whether in the eyes of the ritualists, the Maruts have already become full-fledged wind gods, and more especially wind gods belonging to different seasons". Pathak (1999: 35-36) identified them with Bad-ī-sad-o-bist, seasonal winds blowing in Afghanistan.

Maruts are never mentioned as a single entity. They are always referred as group of gods. Correlating these wind gods with the *cāturmāsya* ceremony, Maruts could be identified with the winds that blow in Afghanistan from June to September. These are aptly called Bad-ī-sad-o-bist, winds of hundred and twenty days. This term can be traced to its Sanskrit roots – *Śata vimśati vatāh (bad: vāta, bist: vimśati, sad: śata).* The RV further supports this proposition. These seasonal winds are known to make roaring sounds with a force. The sound is so powerful that often it is not possible to have conversation in open. Maruts are stated to be singing songs (RV 1.19.4; 1.166.7). They are called the singers (e.g. RV 5.52.1) or singers of heaven (RV 5.57.5). In other *Rc*, they are urged to cross the rivers in Afghanistan.

mā vo rasānitabhā kubhā krumurmā vaḥ
sindhurnir rīramat |
mā vaḥ pari ṣṭhatsarayuḥ purīṣiṇyasme
itsumnamastu vaḥ || (RV 5.53.9)

(Translation: "Let not *rasa*, *krumu*, or *anitabhā* , or *kubhā* , or *sindhu* hold you back, Let not watery *sarayu* obstruct your way, ye bestow us with all the bliss")

The association of the deity Maruts with *caturmasya* ceremony, their roaring sound as that of Bad-ī-sad-o-bist lasting for four months and direct reference to the major river streams in Afghanistan points to a possibility that the Vedic seers perceived them to be originating in Afghanistan.

Vedic Seers On Maruts

Vedic seer *kaṇva ghaur*, who possibly belonged to the Ghor region of Afghanistan, praised Maruts in two hymns, RV 1.37 and RV 1.38. Both hymns are in the *gāyatri* meter. The description in the hymns elaborate on the nature of Maruts.

eheva śṛṇva eṣām kaśā haṣtesu yadvadān |
ni yamajcitramṛñjate|| RV 1.37.3

(Translation by Griffith 1992: "One hears, as though were close at hand, the cracking of the whips they hold; They gather glory on their way")

The roaring sound of Bad-ī-sad-o-bist is described as being deafening and very close and thus the term "cracking of whips" is notable.

ni vo yāmāya mānuṣo dadhra ugraya
manyave |
jihīta parvato giriḥ || (RV 1.37.7)

(Translation: At your approach, man holds him down before fury of your wrath; the rugged-jointed mountain yields)

pra yāta śibhamāśubhiḥ santi kaṇveṣu vo
duvaḥ |
tatro ṣu mādayādhvai || (RV 1.37.14)

(Translation: Come quick with swift steeds, for ye have worshippers among *kaṇva*'s sons; May you rejoice among them well.)

This is allegorical description of the winds blowing at high speeds of more than 160 km per hour.

Received : 11-6-2007
Revised : 10-8-2007
Accepted : 15-8-2007

The Bad-ī-sad-o-bist winds blow for four months and then subside. Aspects of the Bad-ī-sad-o-bist winds are also allegorically described in the RV *Ṛcs*. As Macdonell (1981:78) has summarized: "They are brothers among whom none is oldest or youngest (RV 5.59.6; 60.5) for they are equal in age (RV 1.165.1). They have grown together (5.56.5; 7.58.1) and are of one mind (RV 8.20.1). They have the same birthplace (RV5.53.3) and the same abode (1.165.1; 7.56.1). They are spoken of as having grown on earth, in air and in heaven (RV 5.55.7) or as dwelling in the three heavens (RV 5.60.6). However, Macdonell (1981:78) has identified Maruts as "the clouds charged with rain and lightening". The clouds neither make whipping sounds, nor do they hold a man down. On the contrary Maruts have to be distinguished from clouds, because they induce profuse rains (RV 1.85.5,10), they are wrapped in robes of rains (RV5.57.4), such that kine must to walk in knee deep water (RV 1.37.10) and they carry away the dry, not raining, clouds (RV 1.37.11).

tyam ciddhā dīrham pṛthum miho
napatamamṛdhram |
pracyavayanti yamabhiḥ || RV 1.37.11

(Translation: Before them, on the ways they go, they drop this offspring of cloud, Long, broad, and inexhaustible)

yadyuyam pṛśnimātaro martāsaḥ syātana |
stotā vo amṛtaḥ syāt || RV 1.38.4

(Translation: If, O ye Maruts, ye the Sons whom *prsni* bore, were mortal, and Immortal he who sings your praise).

In the above Rc seer refers to mortality of the Maruts. It is obvious from the fact that these winds blow for the limited period of four months every year. It also confirms these winds to be Bad-ī-sad-o-bist.

Maruts were the harbingers of rains. They were the carriers of rains. Incidentally, the ancient seers were aware of the fact that the formation of clouds takes place from the ocean water and the Maruts propelled the rain making clouds inland.

udīraryathā marutaḥ samudrato yūyam
vṛṣṭim varṣayathā puriṣinaḥ | (RV5.55..5a)

(Translation: O Maruts, from the Ocean ye uplift the rain, and fraught with vaporous moisture pour the torrents down)

Rituals For Maruts

Maruts were prominent deities in the *cāturmāsya* ceremony. They were offered a spotted cow in sacrifice (Hillebrandt 1981, II: 64). In a long hymn RV 8.7. 1-36, seer *punarvatsa kāṇva* refers to participation of Maruts in the Soma sacrifice. He refers to their abode in the region of *suṣoma, Śaryaṇāvat* and *Arjīka* (8.7.29). These three names appear together in two other hymns, RV 8.64.11; 10.75.5. Their location has been debated. The Soma plant was grown in the region named after these locations. As it is now possible to identify the Maruts as deities rooted in Afghanistan, it is possible to locate these three locations in Afghanistan, i.e. towards west of river *Vitastā*, i.e. Jhelum.

Many seers describe Maruts as wielding an axe as their main weapon (RV 1.37.2, 1.88.3, 5.57.2 etc.). In the Rc RV 8.7.32 the seer refers to the golden axe wielded by Maruts.

saho ṣu ṇo vajrahastaiḥ kaṇvāso agnim
marudbhiḥ |
stuṣe hiraṇyavāsībhiḥ || (RV 8.7.32)

(Translation: The Kanvas sing forth Agni's praise together with our Maruts who Wield thunder and bear golden axe)

Maruts are also compared with fire in RV 6.66.2.

Golden Axes For Maruts

Incidentally there is a gold plated silver axe, maximum length 12.68 cm (Fig. 1), with *gaṇḍabheruṇḍa* statue from Afghanistan and dated around 1900-1700 BCE (Pathak 1999: 16).

The following information on the golden axe is quoted from "Ceremonial Axe" (<http//www.georgeortiz.com/TEXT/0140>), which deals with the similar axes found in the region of North Afghanistan and Bactria.

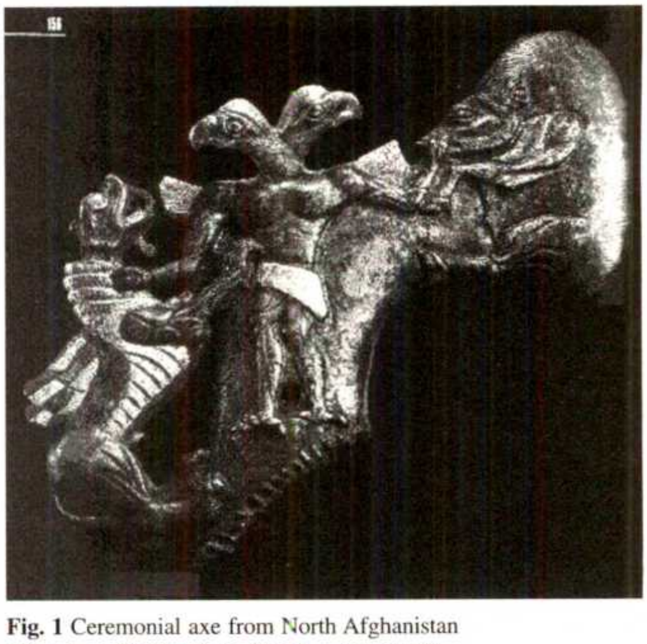

Fig. 1 Ceremonial axe from North Afghanistan *(Courtesy: Metropolitan Museum, New York)*

> "The whole was cast by the lost wax process. The boar covered with a sheet of gold annealed and hammered on, some 3/10 – 6/10 mm in thickness, almost all joints covered with silver. At the base of the mane between the shoulders and an oval motif with irregular indents. The lion and the boar hammered, elaborately chased and polished — the closest parallel stylistically is the famous silver axe in New York with an almost identical shaft opening, but laced with silver wire, and hole for the dowel — The New York axe is ritualistic and clearly thematic as it illustrates some myth, saga or religious belief which may explain a certain stiffness."

There are at least three similar axes reported here. Thus it indicates that the most important Vedic *cāturmāsya* Soma offering sacrificial ritual was popular in the region. These axes were used in the sacrifice.

It is now possible to understand the significance of a bird figure with dual head on the gold plated axe and figures of a lion and a wild boar with pointed tusk depicted on the axe. These two heads of the bird figure represent the dual deity Agni and Maruts who fly high in sky. As indicated in the web article, the axe was possibly used in sacrifices to Agni and Maruts as described in hymn RV8.7.32.

> Maruts are described as roaring like mighty lions:
> *"simhā eva nAnadati pracetasaḥ"* (RV1.64.8)

They are compared with wild boar with pointed tusks:

> *paśyaṇhiranyacakranayodanṣṭrānvidhavato*
> *varāhūn* | (RV 1.88.5b)

[Translation: "What time upon your golden wheels he (Gotama) saw you, wild boars rushing about with metallic tusks"]

The roaring lion on the left and wild boar head with pointed tusk, both are representations of the Maruts as described in these *Rc*s.

This is not the only one piece of its kind. There are a few others. One of these is with the British Museum item number 123268 (Fig. 2). The axe originated in North Afghanistan/Bactria. It was purchased in Pakistan. According to the information given in the catalogue, it is a ceremonial axe dated around 2000 BCE. There are heads of boar, tiger and goat. As given above, these animals are associated with Maruts.

Existence of many such axes with typical animal representation confirm their use in sacrificial ceremonies, Soma sacrifices and that the representation of the deities in animal representation forms following the Vedic tradition of praising deity as animal power.

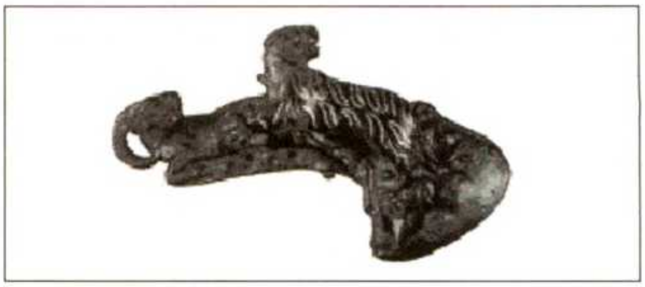

Fig. 2 Ceremonial axe at the British Museum
(Courtesy: British Museum, London)

Conclusions

As proposed by the author in earlier book, "The Afghan Connection" (1999) further ṚgVedic details confirm that the Ṛg Vedic group of gods, Maruts were the annual winds Bad-ī-sad-o-bist blowing for hundred and twenty days from June to September in Afghanistan. The *kāṇva* clan of Rig Vedic seers, some of them certainly hailed from Afghanistan described the Maruts in realistic manner.

Since Maruts and Soma came from the same region of *ṣusoma* and *Arjīka, t*he region was further west of the river Jhelum. As Maruts are stated to be wielding golden axe along with Agni, the golden axes found in Afghanistan were used in ceremonies for Maruts. The *gaṇḍabherunḍa* figure on the axe represents dual deity - Maruts and Agni.

Acknowledgements

Author sincerely thanks Dr. S. Kalyanraman for the review and suggestions, which are incorporated in the revised article. His niece Anuja in London made it possible for inclusion of picture of the Bronze axe. Many blessings to Chi. Anuja for timely help. Author sincerely thanks Rajeev Khanna at the Arya Samaj Library, Houston and staff at the Kendall Branch of Houston Public Library, Memorial Road for the support and making reference books available.

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Book Review

The Aryans: Myth and Archaeology by M.K. Dhavalikar 2007. New Delhi: Munshiram Manoharlal. Pages 226, Price Rs. 600/-

After a lull of a few decades, in the 1960s the Aryan debate slowly revived in the Indian context, as new archaeological findings on the Indus civilization accumulated. A few Western archaeologists and anthropologists (G.F. Dales, J.G. Shaffer, J. M. Kenoyer, J.-F. Jarrige, Edmund Leach, K.A.R. Kennedy, etc.) started rejecting the evidence usually brought forward in favour of an Aryan invasion of, or migration to, India, some of them in vigorous terms. A few Indian archaeologists (D.K. Chakrabarti, B.B. Lal, S.P. Gupta, V.N. Misra, S.R. Rao, J.P. Joshi, etc. followed suit. There was a considerable difference, though: while the former were generally non-committal as regards the origins of Vedic culture and of Indo-European languages, the latter tended to adopt the view that Vedic culture was indigenous, and that it was reflected in Harappan culture. We had, then, broadly three schools of thought: the invasionist/migrationist, which continued to see Indo-Aryans coming to India sometime in the second millennium BCE, the non-committal, and the indigenist; understandably, the first and the last have often been at loggerheads, and in recent years, the debate has acquired occasional stridency.

A fresh contribution has come from Prof. M.K. Dhavalikar, a senior archaeologist well known to students of India's protohistory for his excavations at Inamgaon, among other sites, and for several books, in particular his fine *Indian Protohistory* (New Delhi: Books & Books, 1997). In that book's last chapter, "Archaeology of the Aryans," Prof. Dhavalikar had outlined a few thoughts on the vexed issue; he has now decided to enlarge upon them, not without some trepidation: "I am quite conscious that I am treading a minefield full of dangers at every step, but the problem of Aryan homeland is extremely absorbing" (p. 35). However, despite his adoption of the indigenist school — with a few important differences as we shall see — his patient handling and dispassionate discussion of the evidence will likely keep him immune from the kind of attacks some of his fellow travellers have been subjected to.

To set the tone, Prof. Dhavalikar begins with a brief historical background of the Aryan problem, and presents the views of some of the recent proponents in the field, such as Marija Gimbutas, Colin Renfrew, R.S. Sharma, C.C. Lamberg-Karlovsky, B.B. Lal, S.P. Gupta, K.D. Sethna, Michael Witzel, and a few more. Chapter 2 discusses the main features of Rig-Vedic culture: its date, its geographical setting, its various clans, including the Dasas and Dasyus, its settlements and societal order, its artefacts and religion.

Chapter 3, "Archaeological Traces of the Aryans," is the book's backbone. Like most of his colleagues, Western or Indian, Prof. Dhavalikar accepts the identification of the Vedic Sarasvati with the Ghaggar-Hakra. He proceeds to analyze the pattern of Early, Mature and Late Harappan settlements in the river's lower and upper basin, and finds a considerable increase of Late Harappan sites as we move towards Haryana, pointing to a drying up of the river after the Sutlej and the Yamuna ceased to flow into it; a period of aridity spread over much of the Old World compounded the crisis, which led to the end of the urban phase and triggered an "exodus" of Late Harappans.

At this point, Prof. Dhavalikar introduces his own view that the Late Harappans best fit the descriptions of the Vedic people. They were pre-iron-age (the Rig-Veda does not know iron), had horse-drawn chariots with spoked wheels, would have noticed the visible ruins of Harappan cities (the Rig-Veda mentions ruined sites), lived in villages that fit the Rig-Vedic descriptions, and longed for rain and water as reflected in the Vedic hymns. The Dasas were perhaps the people of the Gandhara Grave culture. Prof. Dhavalikar then draws numerous parallels between the Vedic and the Harappan religions, the latter of course having been inherited by their successors. Bringing into play the skeletal continuity demonstrated by anthropology, he rejects an Aryan invasion or immigration from the North-West in the second millennium, and advances that the Early and Mature Harappans spoke an Indo-European, probably Sanskritic language, yet were not Vedic Aryans: the Vedic religion drew upon the Harappan, but was the creation of the adverse conditions of the Late Harappan phase.

The obvious advantage of this perspective is that it readily explains the various continuities displayed in the archaeological record, which Prof. Dhavalikar points out: between the Mature and the Cemetery H cultures, or between the Late Harappan period and the PGW phase. In other words, the evolution of cultures can be explained without bringing into play an invasion or migration from outside the subcontinent.

The next chapter, "Ancestors of Vedic Aryans," attempts to locate the Aryans' elusive "original home," and is therefore more conjectural in nature. Basing himself on Tilak's research on astronomical data and on certain hymns of the Rig-Veda, Prof. Dhavalikar locates it near the Altai mountain of Central Asia, which he equates with Mount Meru. However, such hymns can be variously interpreted, and Meru does not figure in the Rig-Veda; the statement that "the Puranic tradition is supposed to be much older than the Vedic" (p. 162) will find little acceptance among Indologists. Nor is the evidence from the *Vedanga Jyotisha*, which points to latitude 35° N, of much help, since the northernmost parts of India and Pakistan touch 37° N.

The fifth and last chapter, "Aryan Diaspora," which visualizes Late Harappan migrations towards Iran, Iraq, Central Asia, Anatolia, Egypt and Europe, covers much interesting archaeological and literary material, yet remains largely conjectural too. It is hard, for instance, to see Late Harappans giving shape to the Vedic culture from about 2000 BCE (more likely 1800), composing the Rig-Vedic hymns (which certainly took a few centuries), and having enough time to reach distant Anatolia, where at Boghazkoy the fourteenth-century treaty between Mitannis and Hittites invokes a few Vedic gods. Possible migrations within India are on a surer ground, as some of them are archaeologically attested. The ensuing discussion of Kayatha, Malwa, Jorwe, Prabhas and Rangpur cultures, ending with fresh developments in the Ganga valley (where the continuity between Harappan and OCP cultures is evidenced), is a valuable outline of the great transition of the second millennium.

Prof. Dhavalikar's thesis is bold and original, and cogently articulated. He is, however, "aware that there are still many gaps in this gigantic jigsaw puzzle." It is tempting to point to a few more. If, for instance, we accept that the Sarasvati started drying up before 2000 BCE, it would make little sense for the Late Harappans to praise her, in the Rig-Vedic hymns, as a "mighty river" "flowing from the mountains to the sea." Another problem lies with the adopted purely historical reading of the Rig-Veda, which turns Dasas and Dasyus into distinct "people," even though the text paints them much more as demons; Vedic mythology deserves a deeper treatment before any historical conclusions can be drawn. In fact, the genesis of the Vedic religion is explained away by the Late Harappans' "miserable" life (p. 165); apart from implying a rather bleak view of the Rig-Vedic hymns, it is by no means certain that the Late Harappans lived in such "penury": the urban order had no doubt collapsed, yet at some sites (such as Pirak, where a second yearly crop began to be harvested), there are signs of increased prosperity. Finally, archaeology has been steadily moving away from diffusionist and migrationist models; it is now accepted that other mechanisms can account for the appearance of new cultures, including economic, social, technological and environmental ones, and also long-term interactions between different cultures. Even though Prof. Dhavalikar rightly points out (p. 168) that Indian literature has retained memories of migrations out of the subcontinent, the spread of Indo-European languages and cultures calls for more sophisticated models — which is also why the invasionist / migrationist school has run into a series of dead ends.

Despite such shortcomings, *The Aryans: Myth and Archaeology* is an important addition to the literature on the Aryan problem; the wealth of material it surveys and the originality of its discussions will certainly stimulate the debate, even if a final and complete solution may have to wait for much more evidence to be unearthed.

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Obituary

Swarajya Prakash Gupta (1931-2007)

The passing away of Dr. Swarajya Prakash Gupta on third October 2007 marks the end of an extraordinary life which was an embodiment of total dedication to the study of the country's past, integrity, warm friendship, and altruism. Whatever work he was involved in, he gave his best to it. My first contact with him was in 1964 when he came to the Deccan College to participate in the National Seminar on Indian Prehistory. We were both young and full of enthusiasm and were frequently arguing on some point or the other. However, that not exactly pleasant encounter turned into friendship which kept on maturing with the passage of time. Slowly I started going to Delhi for various engagements in Delhi University, UGC, ICHR, Ministry of Education, National Museum, Ford Foundation, and other institutions, and the frequency of my trips increased as I was nominated on more committees. From the beginning Guptaji insisted that I stay with him. After some time I decided to keep a set of clothing, footwear and necessary toiletries at his place so that I did not have to carry a suitcase every time and could travel with just a handbag with requisite papers and reading material. Staying at his place continued from about 1968 to 2003 when I had to stop traveling due to health reasons. During these numerous stays we came to know each other as thoroughly as any two persons can and our mutual liking and respect went on increasing. However, despite our friendship and informality I always respected Guptaji as an elder brother.

During the last 2-3 years of his life Guptaji's chronic asthama had become severe and he found any physical exertion including walking very strenuous. During the last six months or so he was confined to bed and wheel chair, with oxygen support. But all these difficulties did not diminish his enthusiasm for work nor affect his eternal optimism in the least. I met him at Delhi on 5-6 August this year and was amazed to find him full of plans for a number of publications and expansion of the research Centre he had established in Delhi. On 13 September, that is exactly 20 days before he breathed his last, he wrote me a very emotional letter from the ICU of Rockland Hospital where he was admitted 15 days before. The letter was regarding the manuscript of an introductory book on archaeology which he had written, and which he wanted me to go through, suggest a reading list and illustrations. I promptly replied to him that I will be very happy to honour his wish. Unfortunately, the manuscript has not reached me to this day, and it appears that I will have to live with the guilt of having failed to fulfill his last wish.

Guptaji was born and educated at Allahabad. He passed his M.A. in Ancient History, Culture and Archaeology from Allahabad University in 1954 in the First Class. Later, he joined the first batch of students for the Diploma course in Archaeology of the newly established School (later Institute) of Archaeology of the Archaeological Survey of India. He topped in the examination and received Sir Mortimer Wheeler Gold Medal for securing highest marks in the paper on Field Archeology. Later while in service he obtained Ph.D. from Delhi University and D.Litt. from Magadh University. Dr. Gupta also received LL.B. from University of Allahabad, Certificate in Museology: Institute of Archaeology, University of London and Certificate in Museology, France. He studied at Ecole de Louvre and Ecole de Musee de l'homme.

Guptaji received training in field archaeology through participation in excavations at Nagarjunakonda, Gilund and Kalibangan. At the last two sites he worked under the supervision of the eminent archaeologist, Prof. B.B. Lal, and became his most favourite student. He participated in excavations in Kaushambi (1953), Kunnatur (1956), Gilund (1958-59) and explorations of Buddhist sites in Bihar and U.P. (1970-72). After 2000 he planned and directed his own excavations at the medieval site of Sanjan and early historic port site of Kamrej, both in Gujarat, and carried out one season' s excavation at Kampil (Panchala capital, Kampilya) in U.P. in collaboration with Italian archaeologists.

After completing the Diploma course Guptaji joined the Archaeological Survey of India, and after a brief service joined the National Museum, New Delhi as Keeper of Columbian Art, and served for many years as Assistant Director. Around 1988 he was appointed Director of the Allahabad Museum from which position he retired in 1990.

Dr. Gupta attended several international conferences: The Hague, 1962; Rome 1962, Los Angeles, USA 1982; Southampton 1986; Berlin 1987; New Delhi 1994; Islamabad 2002; and Bangkok 2005. He conducted seminars at the Harvard, University of California at Berkeley, University of Wisconsin, and University of Pennsylvania, Philadelphia. Dr. Gupta conducted field work in Uzbekistan and Tadjikistan with Russian scholars in 1967; visited Buddhist and Stone Age sites in Mongolia in 1966. He gave lectures at several places abroad: Institute of Archaeology, London (1963); IsMeo, Rome (1966); Institute of History, Dushanbe (1967); Institute of Archaeology, Leningrad (1967); Museum of Indian Art, Berlin; Silpadikorn University, Bangkok (2005), Royal University, Pnom Penh, Cambodia (2005).

Dr. Gupta was an institution builder *par excellence.* After retiring from the Allahabad Museum he went back to Delhi and devoted all his time, energy and resources for strengthening the Indian Archaeological Society of which he had become General Secretary after Shri B.K. Thapar relinquished that position sometime in the late 1970s, and developing other institutions under its umbrella. Of these, the most important is the Centre for Research and Training in History, Archaeology and Palaeoenvironment. The Centre has a library, a reading room, an auditorium, Indraprastha Museum of Archaeology, and facilities for drawing, cartography, and photography. One of the important features of the museum is a unique collection of Indian and foreign prehistoric objects donated by the late Dr. A.P. Khatri. All these plus a meeting room and offices for the Centre's Director and other functionaries of the Society are housed in a magnificent four-storey building. Guptaji raised over a crore of rupees for constructing the building and developing the infrastructure for research and other activities. The building stands on a 1.54 acre plot in the Qutub Institutional Area in south Delhi. It has a large, well-maintained lawn and garden facing it. Another building near the entrance to the campus contains Guptaji's living quarters and a couple of guest rooms. Besides, there are living quarters for Class IV employees of the Centre and the Society. The land for the Centre was purchased from funds provided by the Professor Devahuti and her husband, Professor D.P. Singhal. The Centre employs a number of research fellows and has undertaken several important research projects like Atlas of the Indus Civilization and Early Historic Urbanization, with financial support from the ICHR. It regularly organizes lectures and seminars, and is starting a Diploma Course in Archaeology. In 2002 it had organized a Refresher Course in Archaeology for University and College Teachers with financial support from the University Grants Commission. It also has a wing called Helpmates which advises State governments and other institutions in the conservation of cultural heritage. The Centre is a living monument to Guptaji's vision and capacity for action.

Dr. Gupta was instrumental in instituting the Dr. V.S. Wakankar Award with a munificent endowment from the M.P. Government. The award carrying a cash amount of Rupees 21 thousand and a citation is given by the Indian Archaeological Society every two years to a distinguished archaeologist.

Developing the Society and the Centre were Dr. Gupta's life's major mission. He wanted to make the Centre a first rate and financially secure institution of teaching and research in archaeology and allied disciplines. Had he lived for a few more years, he would have certainly for succeeded in realizing his dream. Dr. Gupta had also played an important role in founding the Indian Society for Prehistoric and Quaternary Studies, and for publication of the first issue of the Society's journal, *Man and Environment,* he had taken a loan from his provident fund.

For many years Dr. Gupta edited the Indian Archaeological Society's journal, *Puratattva.* In addition, he founded two other journals, *History Today* and *Journal of Indian Ocean Archaeology.* Dr. Gupta was a visionary and was continuously thinking of expanding the activities of the Society and the Centre, and constructing new buildings on the campus.

Dr. Gupta was a scholar of versatile academic interests, the two principal ones being South Asian Protohistory and Art. The diversity of his research interests is very well reflected in the large number of publications which he authored or edited singly or jointly with other scholars. These include *Tourism, Museums and Monuments, Disposal of the Dead and Physical Types in Ancient India, Archaeology of Soviet Central Asia and the Indian Borderlands, Roots of Indian Art, Indus-Saraswati Civilization, Kushana Art of Sanghol, Masterpieces of the National Museum Collection, Elements of Indian Art, History of Ayodhya* (with T.P. Varma),*Frontiers of the Indus Civilization* (edited with Prof. B.B. Lal), *History of Tibet, Mahabharata: Myth and Reality* (both edited with K.S. Ramachandran), and *India's Contribution to World Thought and Culture* (edited with Lokesh Chandra), besides numerous articles in journals and edited volumes in India and abroad. His *Roots of Indian Art* was translated into French. He was awarded Maulana Azad Gold Medal and Archeological Survey of India's Centenary Celebrations Gold Medal. For his outstanding contribution to archaeology he was given the first Dr. V.S. Wakankar National Award by the Madhya Pradesh Government in 2006, and Prof. R.K. Sharma Award of the Indian Society of Prehistoric and Quaternary Studies.

Dr. Gupta was an effective speaker. He used to mesmerize his audience, particularly while speaking on early Indian Art and Architecture. He had participated in numerous conferences and lectured at many institutions in India and abroad.

Dr. Gupta took keen interest in encouraging and helping other archaeologists, particularly the fledgling ones. For decades his office and home had been a welcome place for archaeologists of all ages and positions and to his numerous friends and admirers. He always had visitors in his office as well as home and received every one with great warmth. Dr. Gupta lived a very simple, almost austere life, but he was lavish in his hospitality. No visitor to his office or home was allowed to leave without having tea and snacks. At his home he always had ample supply of tasty and quality snacks and fruits and he delighted in entertaining people. He hardly ever ate alone and always had people to give him company at breakfast, lunch and dinner. His cook, Dharmendra, prepared delicious dishes and took delight in serving Guptaji and his guests. Guptaji was a charming host and entertained his guests with jokes and anecdotes. He used to laugh heartily and with a child-like innocence.

Although Guptaji never married, he was very fond of children and greatly enjoyed their company and telling them stories and jokes. In the morning while he was reading newspapers, children of the class IV employees would come to him and ask for sweets, and he would never disappoint them because he always had an ample stock of chocolates, toffees and biscuits. He was also greatly attached to his family members, particularly to his mother who stayed with him till her end. He had great respect for his elder brother. His two nephews stayed with him until they got married and settled in life He met all the expenses of their education and helped the younger one financially in setting up his business. For his niece also he was like a father, especially after the death of both her parents.

Guptaji was very generous by temperament, and was particularly considerate to people working for him. He always gave presents, including clothes to his driver, cook and gardener on the occasion of festivals, and brought presents for them whenever he went out of Delhi, particularly abroad. He also helped the families of the colleagues, who died prematurely, with financial support in the marriages of daughters and in finding jobs for the children. He helped one colleague, who lost his job suddenly for no fault of his, in establishing a business of publishing archaeology books.

Guptaji had a large circle of friends, some of them right from his school and college days, but with a few of them he was very close. He used to consult them in all important matters and was very happy when they and their families visited him. He was very loyal to his friends and would go to great lengths in helping them in times of need. His loyalty was steadfast and unwavering. I have several personal experiences of his helping nature, and I would like to recount one of them.

In 1976 I was invited to a conference in France. The organizers had offered me hospitality and registration fee but no travel support, and so I had forgotten about it. Soon after that I happened to be staying with Guptaji in Delhi on my way to Shimla for a meeting. I casually mentioned the conference invitation and the problem of travel funds to him. He said it was no problem and he will find a solution after I am back from Shimla. On my return from Shimla I stopped at Guptaji's place. Without my raising the conference subject, he called his friend, Shri Mittal of D.K. Publishers and asked him to give me an amount of Rs.2000/- which he should adjust against the royalty of a book that I will write. Shri Mittal immediately wrote out a cheque. However, I declined to accept the cheque because I did not want to make a commitment which I may not be able to honour in time. Guptaji appreciated my decision and returned the cheque to Shri Mittal.

Guptaji then took me to his friend, Shri Anil Bordia, Education Secretary of the Central Government and asked him to provide travel funds for me. Shri Bordia took a hand-written application from me to the Education Minister, Prof. Nurul Hasan and got the latter's sanction for the full amount of the travel cost.

Now we encountered another hurdle. Under the rules of the Emergency imposed by the Prime Minister Indira Gandhi in 1975, Indians could not accept foreign hospitality without the government' permission. So Guptaji took me to the Home Ministry where we met a police officer, Mr. Magon. As was his nature, Guptaji praised me sky high and tried to impress upon Mr. Magon how my participation in the conference was important for the country. Mr. Magon heard us and said in a cold voice, "Dr. Misra, most probably you will not go". Never to be deterred and ever optimistic, Guptaji then took me to meet Mr. Vaishnav, a Deputy Secretary, who was more understanding and gave me permission to accept hospitality, and so I was able to attend the conference.

Guptaji was drawn to Rashtriya Swayam Sangh (RSS) from his school days and remained a devoted worker of the Sangh till the very end. He had many friends in the Sangh and also enjoyed close relationship with several RSS, BJP, and VHP leaders. He took keen interest in the RSS sponsored Bhartiya Itihas Sankalan Yojana, and debates regarding the Ram Janmabhoomi movement. He published several books on the history of Ayodhya.

Dr. Gupta lived a very simple, almost austere life. He was a strict vegetarian, a teetotaler, and never smoked. But he did not mind others drinking or smoking in his presence. However, he did not permit drinking in is home.

Dr. Gupta had imbibed the values of simplicity, honesty, altruism, and patriotism from his family and the RSS. He was not religious in the conventional sense of the term. I never saw him performing any rituals at home or visiting a temple for offering worship. His religion was doing his duty conscientiously, living a simple and honest life, and helping others.

At the time of his death Dr. Gupta owned no property. He had built a house in the trans-Yamuna area but later sold it and gave most of the proceeds to the Indian Archaeological Society. In fact, he gave to the Society almost everything that he had. He also donated money to several other institutions including the Indian Society for Prehistoric and Quaternary Studies to which he gave rupees one lakh for instituting a gold medal to be given to a student of the Deccan College who scores highest marks at the M.A. examination.

Dr. Gupta will be greatly missed and fondly remembered by his colleagues, and numerous friends and admirers for a long time to come for his abiding contribution to Indian archaeology in the form of his own research and publications, establishing the Centre for Research and Training in History, Archaeology and Palaeoenvironment, nurturing Indian Archaeological Society and its journal, *Puratattva* for nearly three decades, founding *History Today* and *Journal of Indian Ocean Archaeology*, helping other archeologists, and for his enviable human qualities of simplicity, dedication, integrity, and altruism.

V.N. Misra
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Indian Society for Prehistoric and Quaternary Studies

C/o Department of Archaeology, Deccan College, Pune 411006.

Report of the General Secretary for 2006-2007
(01-04-2006 to 31-03-2007)

The functioning of the Society during the year ending on 31-3-2007 has been quite satisfactory, both academically and financially. The regular activities of the Society were carried out successfully. The financial position is reasonably sound because of the interest accruing on the fixed deposits and annual grant for publication of the Society's Journal *Man and Environment* as well as for organizing the annual conference from the Indian Council of Historical Research (ICHR) and Archaeological Survey of India (ASI). We are grateful to ICHR and ASI for financial support. The audited statement of accounts for the period ending 31-03-2007 is printed in this Volume (XXXII, No.2).

Man and Environment

This is the thirty-second year of the publication of the Journal and twentieth year of its biannual publication. The Journal has maintained its standard and continues to attract a wide range of manuscripts by scholars from within and outside the country. The circulation of the Journal is steadily increasing.

We sincerely thank Mr. Sujit Patwardhan and his staff of Mudra Press, Pune for their excellent cooperation in the production of the Journal.

Annual Conference

The 34th Annual Conference was held, in conjunction with the 40th Annual Conference of the Indian Archaeological Society and 30th Annual Conference of the Indian History and Culture Society on 02-05 December 2006 which was organized by the School of Studies in Ancient Indian History, Culture and Archaeology, Jiwaji University, Gwalior under the overall leadership of Professor R.A. Sharma.

The following life members of the Society participated in the conference:

S.R. Adhyapak, Kumar Akhilesh, Shahida Ansari, R.K. Bansal, Arati Deshpande-Mukherjee, P.P. Dandwate, Nupur Dasgupta, Abdolreza Dashtizadeh, Sushma Deo, P. Binodini Devi, K.N. Dikshit, S. P. Ganvir, A.S. Gaur, Sujata Gautami, S. S. Gore, M.C. Gupta, S.P. Gupta, S.S. Jadhav, P.P. Joglekar, P.S. Joshi, M.D. Kajale, V.C. Kamble, Ismail Kellelu, Alok Kanungo, Giriraj Kumar, R.N. Kumaran, Ms. Kumaran, K. Madhavi, Anup Mishra, V.D. Misra, R.K. Mohanty, Malti Nagar, V.D. Nandy, Rukshana Nanji, J.N. Pal, J.N. Pandey, Shanti Pappu, Ambika Patel, V.N. Prabhakar, Sadasiba Pradhan, Vijay Sathe, T. Satyamurthy, V. Selvakumar, C.V. Sharada, Pranab J. Sharma, K.S. Shukla, Arun Kumar Singh, B.P. Singh, Chanchala Srivastava, Rakesh K. Srivastava, Tilok Thakuria, V.H. Sonawane, A. Sundara, P.K. Thomas and Vijaykumar.

Inaugural Function

The inaugural function of the joint Annual Conference of the three Societies was held at 10.30 am, on 2nd December, 2006 at the Gwalior University Auditorium. R. A. Sharma, Head, School of Studies in Ancient Indian History, Culture and Archaeology, Jiwaji University, Gwalior welcomed scholars from all over the country. Shri A.N. Tripathi, the Transport Commissioner, Government of Madhya Pradesh graced the occasion by inaugurating the four day conference at Gwalior. Dr. Dr. J.N. Gautam, the acting Vice-Chancellor and the Dean of the Arts Faculty, Jiwaji University, Gwalior gave the Predential address. The Chief Guest of the function Shri, J.P. Joshi, the former Director General of the Archaeological Survey of India reviewed the progress of Indian Archaeology since the 19th century. Dr. Vandana Kaushik, General Secretary, Indian History and Culture Society, Dr. P.K. Thomas, General Secretary, Indian Society for Prehistoric and Quaternary Studies, Dr. S.P. Gupta, Chairman, Indian Archaeological Society, spoke for their respective Societies.

Presidential Address

The Presidential Address of the Society was delivered by Professor V. D. Misra, Former Head of Department of Ancient History, Culture and Archaeology, University of Allahabad on "Stone Age Cultures, their Chronology and Beginning of Agriculture in North-Central India". *Man and Environment* XXXII (1):1-14 [2007]

Professor H. D. Sankalia Memorial Lecture

The Sixteenth Professor H.D. Sankalia Memorial Lecture was delivered by Dr. Shobhana Gokhale, Retired Reader, Department of Archaeology, Deccan College Post-Graduate and Research Institute, Pune on "The Buddhist Literary Traditions as Reflected in Western Indian Cave Inscriptions and Architecture with special Reference to Kanheri Caves". *Man and Environment* XXXII (1):15-22 [2007]

The Academic Sessions

The academic sessions of the conference were held from 2-5 December 2006 and the following papers were presented.

Abdolreza Dashtizadeh: Survey of a Palaeolithic Region, So-adat Shahr's plain in North-east Fars Province-Iran.

Sushama Deo, S.N. Rajaguru and P.P. Joglekar: Geoarchaeological Investigations in the Man Basin, Solapur District, Maharashtra.

Vijay Sathe: Prehistoric Fauna and Environmental Interpretations: A Case Study from the Manjra Valley.

Anup Ranjan Mishra: Climatic Fluctuations vis-à-vis changes in Ceramic Techno-typology in Mature to Late Ahar Phase at Balathal.

A.S. Gaur and Sundaresh: Coastal Archaeological Investigations along Saurashtra Coast.

R.K. Mohanty and Monica L. Smith: Excavations at Sisupalgarh, Orissa, 2005-2006.

Anup Ranjan Mishra and U.P.Arora: Excavations at Abhaipur, Pilibhit, U.P., 2001-2005.

Amol N. Kulkarni and P.P. Joglekar: Preliminary Observation of Archaeological Sites on Terna River in Osmanabad District, Maharashtra.

Ambika Patel: Conservation and Restoration of Copper Objects from Bagasra, a Mature Harappan Site, Gujarat.

Vasant Shinde and Shrikant Jadhav: Importance of Junnar in the Indo-Roman Trade.

Karuna Shankar Shukla: 'Pur' in the Indian Seals and Sealings.

P.K. Thomas and Arati Deshpande Mukherji: Faunal Remains from Bhirrana a Harappan Settlement in Haryana: Some preliminary Observations.

Somnath Ghosh, Ravi Mohanty and Suparna Ghosh: Organic Residue Analysis of Potteries-An Emerging Field of Investigation.

M.D. Kajale, V. Tripathi, V. Shobha, A.K. Singh and D. Pujari: Plant Economy from Excavations at Agiabir, Mid-Ganga valley: Initial Results.

R.N. Kumaran and M. Saranya Kumaran: Beads from Tandikudi, Tamil Nadu.

V.N. Prabhakar: Long Barrel Cylindrical Beads and the Long Distance Trade of the Harappans.

Shahida Ansari: Coins from Kopia Excavation.

Shilpa Gore: Siddeshwar Temple at Akola, Maharashtra.

P.P. Dandwate and B.S. Gajul: Mahadeva Temple, Ambarnath: Architectural and Iconographical Perspective.

Rakesh Kumar Bansal and Bina Gandhi Deori: The Problems faced by Travellers, Traders and Merchants During the Mughal Period (1526-1707 A.D).

Rakesh Kumar Bansal and Bina Gandhi Deori: The Envoys and Their Role (1526-1707 A.D).

V.D. Misra, J.N. Pal and M.C. Gupta: New Light on the Neolithic Culture of Eastern Uttar Pradesh: Evidence from Hetapatti (Allahabad).

J.N. Pal and M.C. Gupta: Neolithic Ceramic Industry at Jhusi, Allahabad.

Sujata Gautam: Saiva Iconography (From Beginning to 13th Century A.D.: With Special reference to Gwalior Fort.

C.V. Sharada and P.P. Joglekar: Understanding Post-depositional Bone-modification Process; An Actualistic Approach.

Ismail Kellelu and Pradeep Meshram: Excavation at Vyahad, Dist. Nagpur, Maharashtra.

Tilok Thakuria and R.K. Mohanty: Artifacts from Vidarbha Megalithic Culture:Their Functional Analysis.

Arun Kumar Singh: Barselas of Himachal Pradesh at Mandi.

Pranab Sharma: The Dhansiri-Doyang Route of Trade: A Hypothesis.

Vijaykumar: The Copper Hoard Anthropomorphs and the Vedic Marutis: A Comparative Study.

New Life Members

The following persons joined the family of life members of the Society during 2006-2007:

Ms. Ruben Banerjee, Ms. Farida Sarhadot, Ms.Fareshteh Sarhadot, Ms, Poonam Chaudhari, Shri Vijay Kumar, Shri Abdolreza Dashtizadeh, Ms. C.V. Sharada, Shri Midit Trivedi, Shri Vinay Deviprasad Nandy, Ms. Sujata Gautam, Shri Anil Kumar Dubey, Ms. Rima Hooja, Shri Prakash Narhar Godse, Ms. Tosabanta Pradhan, Shri N. Subramaian, Ms. V. Shobha, Ms. Chumbeno Ngullie, Ms. Kanchana Bhagwan and Shri Tejas Garge

Meeting of the Executive Committee

Minutes of the Meeting of the Executive Committee

A meeting of the Executive Committee of the Society was held at the Department of Ancient Indian History, Culture and Archaeology, Jiwaji University, Gwalior, at 15.00 hrs on 4th December 2006. The meeting was presided over by Dr. S.P. Gupta. The following members were present.

1. Dr. S.P. Gupta, 2. Dr. M. C. Gupta, 3. Dr. Alok Kanungo 4. Dr. P. K. Thomas, 5. Dr. P.P. Joglekar, 6. Dr. K. Ismail, 7. Dr. Arati Deshpande-Mukherjee, 8. Dr. S.G. Deo and 9. Dr. A.S. Gaur

Dr. R.C. Agrawal, Dr. V.N. Misra, Dr. Ajitprasad, Dr. K.K. Basa, Dr. V.D. Gogte, Dr. Rakesh Tewari, Dr. Shanti Pappu and Dr. S. Selvakumar were unable to attend the meeting.

At the outset, the General Secretary, Dr. P.K. Thomas, welcomed the members. He apprised the Committee about the major activities of the Society during 2005-2006. These include details of the 33rd Annual Conference held at Bangalore by the M.H. Krishna Institute Indology, Bangalore, Department of Sanskrit, Bangalore University and the Directorate of Archaeology and Museums, Government of Karnataka under the overall leadership of Professor S. Nagaraju, on 15-18th December 2005, and the publication of Vol. XXX (1) & (2) of *Man and Environment*. He also apprised the Committee of the details of the audited statement of Society's income and expenditure during 2005-2006, which is printed in *Man and Environment* XXXI (2). The Society's financial situation remains reasonably good.

To encourage more students to attend the Conference of the Society, it has been decided to allow the students at a nominal fee of Rs. 100/- to participate in the Conference. However, they will not be entitled for the Journal.

Meeting ended with a vote of thanks to the Chair.

Meeting of the General Body of the Society

The General body meeting of the Society was held at the Department of Ancient Indian History, Culture and Archaeology, Jiwaji University, Gwalior, at 14.30 hrs on 5th December 2006. The meeting was presided over by Professor V.D. Misra. The following members were present.

S.R. Adhyapak, Kumar Akhilesh, Shahida Ansari, R.K. Bansal, D. Bhengra, Arati Deshpande-Mukherjee, P.P. Dandwate, Nupur Dasgupta, Abdolreza Dashtizadeh, Sushma Deo, P. Binodini Devi, K.N. Dikshit, S. P. Ganvir, A.S. Gaur, Sujata Gautami, Shobhana Gokhale, S. S. Gore, M.C. Gupta, S.P. Gupta, S.S. Jadhav, P.P. Joglekar, P.S. Joshi, M.D. Kajale, V.C. Kamble, Ismail Kellelu, Alok Kanungo, Giriraj Kumar, R.N. Kumaran, Ms. Kumaran, K. Madhavi, B.R. Mani, R. N. Misra, Anup Mishra, V.D. Misra, R.K. Mohanty, Malti Nagar, V.D. Nandy, Rukshana Nanji, J.N. Pal, Shanti Pappu, Ambika Patel, V.N. Prabhakar, Sadasiba Pradhan, Vijay Sathe, T. Satyamurthy, V. Selvakumar, C.V. Sharada, Pranab J. Sharma, K.S. Shukla, Arun Kumar Singh, B.P. Singh, Chanchala Srivastava, Rakesh K. Srivastava, Tilok Thakuria, V.H. Sonawane, A. Sundara, P.K. Thomas and Vijaykumar.

The following business was transacted at the meeting.

At the outset, the General Secretary, Dr. P.K. Thomas, welcomed the members and presented the report of the activities of the Society for the year 2005-2006. The members of the Society unanimously approved it.

The General Secretary placed the Annual Audited Statement of the Accounts for the year 2005-2006 before the General Body, and the members present unanimously approved it.

President of the Society for 2007

Dr. P.K. Thomas proposed the name of Prof. (Retd.) A. Sundara, Dharwad, as President of the Society for the next year. The proposal was unanimously accepted by the members present.

Professor H.D. Sankalia Memorial Lecturer for 2007

Prof. V.D. Misra proposed the name of Prof. V.H. Sonawane, Department of Archaeology and Ancient History, M.S. University of Baroda, Vadodara, Gujarat for Prof. H.D. Sankalia Memorial Lecture for 2007. The members present unanimously approved the proposal.

The 4th Professor R.K. Sharma Award for Excellence in Archaeology

In recognition of the valuable contribution made by Shri J.P. Joshi to Indian Archaeology, over a period spanning more than fifty years, the fourth Professor R.K. Sharma Award for Excellence in Archaeology will be honoured to Shri J.P. Joshi at the Conference Venue in Raipur, Chhattisgarh.

The meeting ended with a vote of thanks to the Chair.

10-11-2007

P.K. Thomas
General Secretary

INDIAN SOCIETY FOR PREHISTORIC AND QUATERNARY STUDIES

c/o Department of Archaeology, Deccan College, Pune 411 006

BALANCE SHEET AS ON 31st MARCH 2007
REGN- GUJ - 508 - AHMEDABAD

Funds and Liabilities	Rs.	Rs.	Properties and Assets	Rs.	Rs.
Trust Funds or Corpus			**Immovable Properties**		76,547.00
Bal. as per prev. B/S.	656,108.52		Computer System	52,317.00	
Adjustment during the year			Cupboards	8,560.00	
(Donations recd during the year)	0.00	656,108.52	Dead Stock	940.00	
			Fan Parchase	240.00	
			Furniture & Fixtures	14,490.00	
Created under the provisions of the trust deed or scheme or out of the income)			**Investments**		1,898,383.44
			(As per Schedule II)		
Depreciation Fund					
Sinking Fund			**Other Movable Properties**		0.00
Reserve Fund	1,365,902.84	1,365,902.84			
			Current Assets		
For Expenses	0.00		Sundry Debtors	6,582.00	6,582.00
other deposits	0.00				
Audit fee PROVISION FOR	2,360.00		**Cash & Bank Balances**		
Amt Payable	0.00		Cash	586.77	
Other Liabilities	788.94	3,148.94	Bank Balances	122,453.97	123,040.74
Income & Expenditure A/c.			**Income & Expenditure A/c.**		
Bal. as per prev. B/S.	0.00		Bal. as per prev. B/S.		
Less: Appropriation if any	0.00		Add: Deficit for the year		
Add: Surplus ofInc & Exp A/c	79,392.88				
Less: Trf. to General Reserves	0.00	79,392.88			
Total Rs.	**2,104,553.18**		Toral Rs.		**2,104,553.18**

As per our report of even date

For A.G. OGALE & ASSOCIATES
Chartered Accountants

M No. · 043811
Place : Pune
Datte ·1.11.2007

A.S. CHANDVANKAR
Partner

(P.K. Thomas)
GENERAL SECRETARY

(P.P. Joglekar)
JOINT SECRETARY

(Arati Deshpande-Mukherjee
TREASURER

INDIAN SOCIETY FOR PREHISTORIC AND QUATERNARY STUDIES,

c/o Department of Archaeology, Deccan College, Pune.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31st MARCH 2007

REGN- GUJ - 508 - AHMEDABAD

Expenditure	Rs.	Rs.	Income	Rs.	Rs.
To Expenditure in respect of Repairs & Maintenance	0.00	0.00	By Rent (accrued)/(realised)		0.00
			By Interest (accrued)/(realised)		
			On deposits (FD)	54,700.00	
To Expenses on the object of the trust (as per schedule – A)			On Bank Account	3,789.00	58,489.00
			By Publication Grant – ICHR		108,000.00
Conference Expenses	85,587.87		By Publication Grant – ASI		25,000.00
Publication Expenses	158,031.00		By Conference Grant – ICHR		45,000.00
Other Expenses	6,237.00	249,855.87	By Cost of monographs – DHP ETC		10,345.00
			By Life Membership Fees		34,500.00
To Contribution and Fees		0.00	By Sale of M & E volume		67,405.00
To Depreciation		19,490.25	By Deficit carried over to B/s		
To Surplus carried over to B/s		79,392.88			
Total Rs.		**348,739.00**	Total Rs.		**348,739.00**

As per our report of even date

For A.G. OGALE & ASSOCIATES
Chartered Accountants

M No. : 043811
Place : Pune
Datte : 1.11.2007

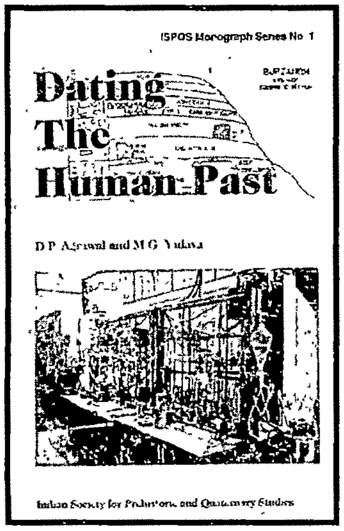
A.S. CHANDVANKAR
Partner

(P.K Thomas)
GENERAL SECRETARY

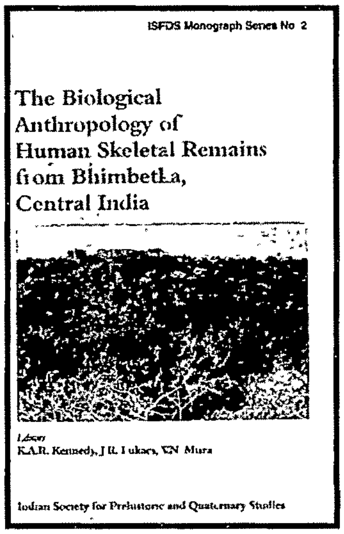
(P.P. Joglekar)
JOINT SECRETARY

(Arati Deshpande-Mukherjee
TREASURER

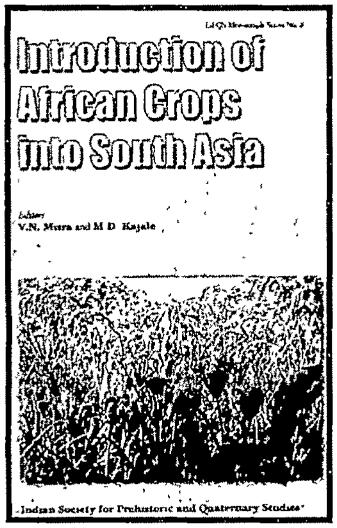
ISPQS PUBLICATIONS


ISPQS Monograph Series No 1
Dating The Human Past
D P Agrawal and M G Yadava
Indian Society for Prehistoric and Quaternary Studies

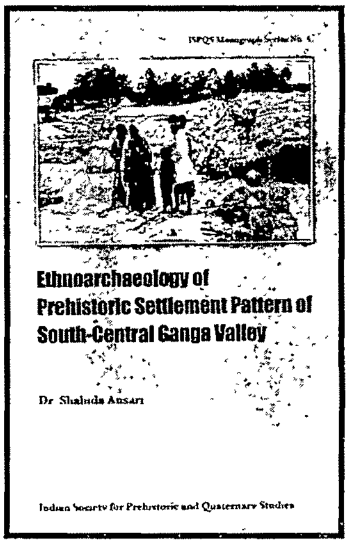
Paperback Rs. 125/-
Hardbound Rs. 250/-


ISPQS Monograph Series No 2
The Biological Anthropology of Human Skeletal Remains from Bhimbetka, Central India
Editors
K.A.R. Kennedy, J.R. Lukacs, V.N. Misra
Indian Society for Prehistoric and Quaternary Studies

Paperback Rs. 190/-
Hardbound Rs. 250/-


ISPQS Monograph Series No 3
Introduction of African Crops into South Asia
Editors
V.N. Misra and M D Kajale
Indian Society for Prehistoric and Quaternary Studies

Paperback Rs. 250/-
Hardbound Rs. 300/-


ISPQS Monograph Series No 4
Ethnoarchaeology of Prehistoric Settlement Pattern of South-Central Ganga Valley
Dr Shahida Ansari
Indian Society for Prehistoric and Quaternary Studies

Paperback Rs. 250/-

- Man and Environment volumes 1 to 9 are not available
- Man and Environment volumes 10 to 26 Rs. 400/- each per issue
- Man and Environment volumes 27 to 32 Rs. 600/- each per issue

Please send the DD in favour of "**General Secretary, ISPQS**", payable at Pune drawn on any Nationalised Bank and place your orders with the Assistant Secretary.

Statement about ownership and other particulars about periodical to be published in the first issue very year after the last day of February.

FORM IV

1. Place of publication : c/o Department of Archaeology
Deccan College, Pune 411 006

2. Periodicity of its publication : Half yearly

3. Printer's Name : Mr. Sujit Patwardhan
Nationality : Indian
Address : Mudra, 383, Narayan Peth, Pune 411 030.

4. Publisher's Name : Dr. P.K. Thomas
Nationality : Indian
Address : 3, Prashant Apts., Deccan College Road,
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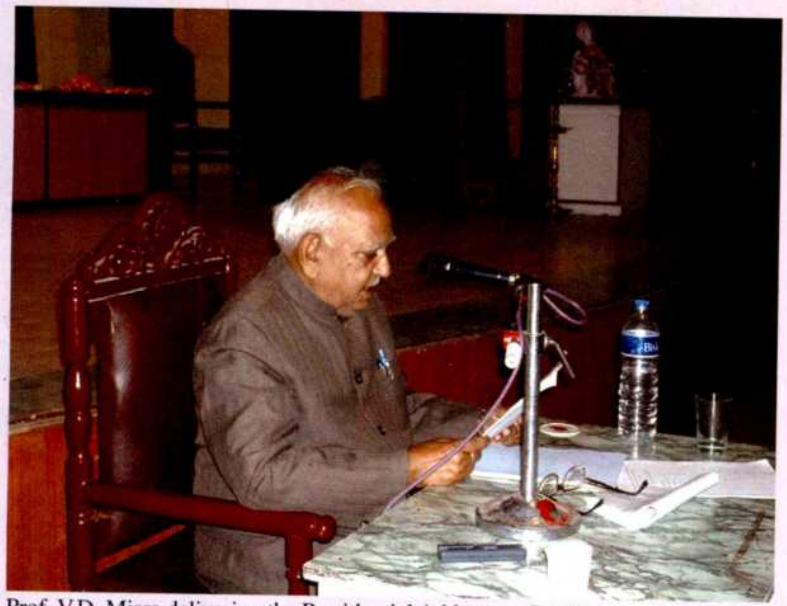

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2-5 DECEMBER 2006
A.I.H.C. & ARCHAEOLOGY, JIWAJI UNIVERSITY, GWL.

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ISSN: 0258-0446

Volume XXXII, No. 2 (July-December 2007)

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Publisher
Indian Society for Prehistoric and Quaternary Studies
c/o Department of Archaeology
Deccan College, Pune 411 006

Printers
Mudra
383, Narayan Peth
Pune 411 030

Price: Rs. 600.00